

SURGERY

Gynecology and Obstetrics

An International Journal of Surgery

FRANKLIN H. MARTIN, M.D.

Founder and Managing Editor 1905-1935

t

Volume 69

JULY TO DECEMBER, 1939

PUBLISHED BY

THE SURGICAL PUBLISHING COMPANY OF CHICAGO

54 EAST ERIE STREET, CHICAGO, ILLINOIS, U. S. A.

LOYAL DAVIS, EDITOR

Associates

SUMNER L KOCH MICHAEL L MASON

CONSULTING EDITORS

UNITED STATES AND CANADA

WILLIAM J MAYO

GEORGE CRUIFF

J BENTLEY SQUIER

FRANK H LAHEY

WALLACE J FERRY

HARVEY CUSHING

WILLIAM R CUBBINS

PHILIP H KREUSCHER

DONALD C BALFOUR

W EDWARD GALLIE

JOHN M I LINNEY

WALTER W CHIPMAN

FREDERIC A BESLEY

PHILIP D WILSON

GREAT BRITAIN

SIR JAMES WALTON

J R LEARMONTH

G GREY TURNER

Argentina

Australia

Brazil

JOSE ARCE

SIR ALAN NEWTON

LINCOLN DE ARAUJO

Scandinavia

France

Holland

Italy

EINAR KEY

ANTONIN GOSSET

JAN SCHOEEMAKER

VITTORIO PUTI

COPYRIGHT BY THE SURGICAL PUBLISHING COMPANY OF CHICAGO, 1939

CONTRIBUTORS TO VOLUME 69

ADAMS JOHN C	717	GOERINGER C IRFD	48	MARSHALL SAMUEL I	495
ALESSANDRI ROBERTO	765	GOLD RUBIN L	291	MAYO CHARLES W	110
ANDERSON ROGER	770	GOLDBLATT MYRON	65	MCCALGHAN JOHN M	530
ANSON BARRA J	468	GORDON CHARLES A	631	MCFARLAND R W	327
ARNELL RUFERT E	518	CRATZ CHARLES MURRAY	627	MEYDINGER FREDERICK C	299
		GROSS ROBERT I	48	MEYER L H	627
BARDER C GLEN	618	GROSSMAN ABRAHAM	234 373	MEYER JOSEPH VINCENT	251 319 645
BARGE J ARNOLD	136	GUTHRIE DONALD	118	MENGERT WILLIAM I	615
BARTH E E	105			MEYERDING HENRY W	267
BECKER R T	702	HANS W R	200	MILLER DOUGLAS	95
BEER EDWIN	113	HARGRAVE ROBERT	67	MOORE K M	146
BERNABEO EUGENIO	333	HARRINGTON STUART W	364	MORA J M	178
BICK EDGAR M	524	HARTZELL JOHN B	660	MURPHY WILLIAM K	711
BISGARD J DEWEY	98	HINMAN FRANK	713		
BORTNICK A R	577	HOBBS JOHN E	577	NATHANSON IRA T	484
BOTSFORD THOMAS W	441	HOEBEL FREDERICK C	745	NECHELIS H	281
BRADFORD F KEITH	446	HOERR STANLEY O	726	NELSON GUY M	120
BRODERS ALBERT C	267	HOPPS HOWARD C	637	NEVILLE J V H	240
BURTON CLAUDE C	688	HORRAA GILBERT	828		
		HUBBY ALLAN J	804	OIFELNHEIMER ALBERT	83
CAMPBELL WILLIS C	697	HUNT VERNE C	115	ORR H WINNETT	825
CARNES EDWIN H	247	HUTCHINS ELLIOTT H	795	ORR THOMAS G	657
CHAFFIN LAWRENCE	337				
CHANDLER FREMONT A	101	JAYE HENRY L	257 645	PADGETT I ARLE C	770
CHESLEY ELIZABETH R	436	JOHNSON WILLIAM W	684	PEMBERTON JOHN D J	417
CHESLEY LEON C	436	JOHNSTON H W	809	POLLOCK GEORGE A	648
CHRISTOPHER FREDERICK	637			PRICE THILIP B	504
CLEVELAND RUCKER	18	KALANJIAN BERNARD	221	PRIESTLEY JAMES I	699
COFFEY ROBERT J	136	KAUFMAN LOUIS RENE	684		
COMFORT M W	531	KEY J ALBERT	508	RAMOS RAUL L	688
CONNELL I GREGORY	287	KINSELLA THOMAS J	252	RAND CARL W	400
CONWAY HERBERT	756	KRETSCHMER HERMAN L	671	REDFUS DAVID I	460
CRILE GEORGE JR	39	KRIDA ARTHUR	106	REHFUSS MARTIN I	120
CUTLER ELLIOTT C	702	KULOWSKI J	312	RICHTER H M	178
				ROGERS LANBERT	659
D ABREU A L	209	LAHEY FRANK H	498 826	ROSENTHAL ALFANDER H	631
DALAND ERNEST M	347	LANGMAN LOUIS	65		
D'AVILA B	231	LAUGHLIN KENNETH A	615	SACHS LOUIS	515
DAVIS M EDWARD	124	LESSER ALBERT	684	SALEEBY GEORGE W	83
DAVISON RICHARD	804	LEVINTHAL DANIEL H	234	SALTSTEIN HARRY C	111
DE TAKATS GEZA	762	LEWISohn RICHARD	125	SAMUELS SAUL S	342
DUNPHY J L	441	LEWISON EDWARD F	694	SCHINDLER RUDOLF	281
		LEYDIG S M	508	SCHNEEDORF J G	305
FERTITTA JULIAN J	518	LICHTEINSTEIN MANUEL E	327	SCHNEIDER GILBERT	804
FINSTERER H	291	LIEBERTHAL FREDERICK	159	SCHULZ M D	705
FOSS HAROLD L	380	LUED SAMUEL	155	SCOTT W W	663
		LUND CHARLES C	117	SEEDER STANLEY J	207
GARDNER CLARENCE E JR	103			SPIDLER FERDINAND	101
GERWIG WALTER H JR	474	MACDONALD DEAN	70	SEVERANCE ALVIN O	645
GORMLEY RALPH K	251 648	MACEY HARRY B	108	SHIPLEY ARTHUR M	474
GIBBON JOHN H JR	602	MACLEAN NEIL JOHN	816	SIMMONS CHANNING C	171
GLENN FRANK	431	MARDEN PHILIP A	61	SINGLETON A O	146

SMITH CLEMENT A	584	WAGNER D H	178	WILLIAMSON ERNEST G	61
SOPHAN LAWRENCE	818	WALKER, KENNETH	493	WILSON KARL M	663
SOROCK MILTON L	669	WALTMAN RICHARD	153	WILSON WILLIAM D	110
SPaulding E H	738	WANGENSTEEN OWEN H	534	WINDLE W F	105
SPURLING R GLEN	446	WARREN SHIELDS	645 726	WOLFER JOHN A	468 143
		WEINBERGER LAURENCE M	353	WRIGHT ROBERT R	468
TAYLOR GRANTLEY W	171 454	WELCH CLAUDE E	171		
THOMPSON CHARLES I	221	WEYRALCH HENRY M JR	183 713	ZONDEK BERNHARD	214



Fig. 2



Fig. 11



Fig. 8 A



Fig. 8 B



Fig. 17



Fig. 19

SURGERY

GYNECOLOGY AND OBSTETRICS

An International Magazine, Published Monthly

VOLUME 69

JULY, 1939

NUMBER 1

GASTROSCOPY IN GASTRIC CARCINOMA

Especially in Its Early Diagnosis

RUDOLF SCHINDLER, M.D., Chicago, Illinois
RUBIN I. GOLD, M.D., San Francisco, California

THE importance of gastroscopy in the early diagnosis of gastric carcinoma is disputed, although gastroscopists recognize its value in the differential diagnosis of benign and malignant lesions, and in the determination of operability. Cutzler agrees that gastroscopy is of great value in the study of gastric carcinoma, but he does not believe that it will facilitate the early diagnosis. Moutier deems it impossible to diagnose an early gastric carcinoma either roentgenologically or gastroscopically, except in the stomach. Henning, who was skeptical, now states that gastroscopy would be important in the early diagnosis, were it widely performed. René Chevlier, who has made valuable contributions to this subject, contends that gastroscopy is superior to x-ray in some cases for the diagnosis of early carcinoma, and has published such cases. Benedict (2), who

introduced gastroscopy in this country, has experienced the importance of the method in the early diagnosis. Schloss is hesitant in admitting the value of the method for this purpose. Schindler (35), as early as 1923, felt that gastroscopy would advance the early diagnosis of carcinoma, and presented 3 illustrative cases at that time.

We shall consider an "early" diagnosis of gastric carcinoma as one in which the lesion is very small, without clinically detectable metastases, invading no small area that surmised removal may be undertaken hopelessly. Other definitions have been used. Schindler (37, 38) has employed the term to mean a diagnosis which makes it possible to effect a "cure" of from 3 to 5 years after operation. The latter definition applies to the lesion of the size usually detected. However, with very small growths, the first definition is more practical.

Fig. 2 Case 1. Gastroscopic picture observed July 17, 1938. Antrum and pylorus are seen. The pylorus is small and not round. Behind two nodes on the greater curvature, a small (carcinomatous) ulcer is present.

Fig. 8 Case 2. Two gastroscopic views of a small carcinoma. In a, the greater curvature is visualized. A prominent wall with a superficial ulceration is seen. In b, the posterior wall is observed. The protruding tumor surface is much magnified.

Fig. 11 Case 3. Gastroscopic picture of a polypoid tumor lying in a completely atrophic mucosa.

Fig. 17 Case 6. Gastroscopic view of the anterior wall of the stomach, showing tremendous nodular infiltration and tumor-like protrusion of a fold. This picture is suggestive, but not conclusive, of carcinoma.

Fig. 19 Case 9. Gastroscopic picture of a type III carcinoma. At the right (3 o'clock), antrum and open pylorus are seen. The carcinomatous ulcer is limited toward the pylorus by a nodular wall. However, at 7 and 9 o'clock, no sharp limitation of the ulcer can be seen, evidence of infiltration. Between 10 and 1 o'clock, the overhanging posterior wall appears.

aminations which, in turn, permitted the incidental discovery of the small carcinoma. In this respect the case should be compared to Case 2 in which the incidental discovery of the lesion is even less questionable.

CASE 2 No 200796 A man aged 59 years seen June 24, 1938 had suffered progressively increasing weakness with ascending numbness in the lower extremities for 3 years. At the onset of symptoms a diagnosis had been made of pernicious anemia with combined cord degeneration. Liver extract had been prescribed but irregularly taken. In April, 1938 he was observed in another hospital and treated with liver extract and transfusions. Roentgen studies were made in the course of a routine examination and a filling defect seen in the *pre pyloric area* suggesting a carcinoma (Fig 7) (Examination of these films here indicated the apparent defect was produced by pressure of the spine since mucosal folds were present at this site in the relief films). There was a loss of 15 pounds in the past 2 months and increasing constipation but the appetite remained good. In the last week he was unable to walk owing to neurological changes. No definite gastric symptoms were present.

Physical examination disclosed an obese pale male with neurological signs of subacute combined cord degeneration.

Laboratory examination revealed hemoglobin 78 per cent red cell count 3,400,000 with blood smear characteristic of pernicious anemia. Wassermann and Kahn tests were negative. Stools gave a 4 plus reaction for occult blood. Gastric analysis revealed a histamine refractory anacidity.

Roentgen ray and gastroscopic examinations gave the following results. Roentgenogram on June 27 showed that the stomach and duodenum were normal. In view of the outside x ray diagnosis of carcinoma gastroscopy was advised.

Gastroscopic examination was made on August 1 (Fig 8 A and B front piece). The paralysis of the lower extremities caused some difficulty but the examination was complete. The pylorus was observed in full activity. Although the antrum mucosa was slightly swollen no tumor was seen. A gray atrophic patch was seen above the muscular sphincter antri. When the objective was turned toward the posterior wall of the mid portion of the stomach in the course of the routine examination a prominent tumor appeared in the field. It was limited by a wall the edge of which was necrotic. There was no demarcation toward the posterior wall the tumor passing gradually into the dark red neighboring mucosa at this point. Toward the greater curvature separated from the tumor mass by a bridge of normal mucosa a small polypoid tumor was seen. A diagnosis was made of type III carcinoma of the mid portion of the posterior wall near the greater curvature with atrophic gastritis.

A repeat roentgenogram was made on August 2 in view of the gastroscopic diagnosis of carcinoma. The

findings were again negative. However the patient was difficult to examine because of his obese abdomen and inability to use his legs.

Operation was performed on August 11. A small carcinoma was found in the mid portion of the stomach on the posterior wall close to the greater curvature. There was no evidence of metastases. A subtotal gastrectomy was performed. The patient expired 3 days later from a pulmonary embolus.

Pathological examination. The tumor (Fig 9) is 4 by 1.7 centimeters lying on the posterior wall close to the greater curvature. There is a limiting wall at the greater curvature side. At the upper portion toward the posterior wall there is a diffuse infiltration without sharp demarcation. A shallow ulceration 1.2 centimeters in diameter is present. **Microscopically** (Fig 10) an adenocarcinoma is seen penetrating into the submucosa the stroma of which contains many cells. The depth of the surrounding mucosa and the number of glands are reduced. There is a tremendous cellular infiltration consisting of lymphocytes plasma cells and eosinophiles. At some places metaplasia of the epithelium is present (atrophic gastritis). The lymph follicles are increased in size and number.

In this case an early gastric carcinoma was diagnosed because a patient with pernicious anemia was examined gastroscopically in spite of the negative roentgen observation. There were no symptoms definitely referable to the stomach. However the roentgenologist advised gastroscopy despite his normal findings which shows the need for close co-operation between roentgenologist and gastroscopist. Had this patient been examined earlier gastroscopically, it is quite probable that a smaller lesion would have been detected.

The procedure of the outside hospital in making a complete examination with x ray studies was commendatory although a diagnosis of pyloric tumor was incorrectly made due to faulty interpretation. Careful roentgen re-examination failed to reveal a tumor. The value of gastric roentgen relief studies for the early diagnosis of carcinoma should not be underrated because of the presentation of this case. However there are cases in which gastroscopy is superior to careful relief technique. Four similar cases have been reported by Katsch, Benedict (2), and Moersch and Snell mention this occurrence.

This case and the one following demonstrate well the value of periodic examinations for the early recognition of gastric carcinoma in pa-



Fig 1 Case 1 Roentgenogram July 16, 1938 showing a fleck suggestive of pyloric ulcer

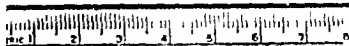


Fig 3 Case 1 Drawing of the resected specimen The pyloric ulcer was so shallow that it was obscured in the photograph In the drawing it appears deeper than actually for the purpose of demonstration

tients with atrophic gastritis This subject is further discussed later There is some evidence of an increasing frequency of gastric lesions in the course of pernicious anemia (44) Chronic atrophic gastritis is the predisposing factor for the development of gastric polyps and carcinoma, according to Konjetzny (20), and others If this is true, Hurst (14) suggests an increase in the incidence of gastric carcinoma in pernicious anemia patients is to be expected, as a result of the more adequate treatment with extension of the life expectancy Benedict (3) mentions the incidental discovery of 2 cases of gastric carcinoma, in the gastroscopic examination of several cases of deficiency disease with atrophic gastritis (one a pernicious anemia, the other a Plummer Vinson syndrome), which were confirmed by x ray and resected

CASE 3 No 188610 An attorney aged 58 years seen February 20 1938, complained of indefinite gastro intestinal distress for 20 years In 1928, gastric analysis revealed free acid But during the last 10 years several examinations showed acidity after histamine In the last 5 years there was a progressive state of weakness and fatigue, developing into marked exhaustion on little effort As a result a formerly very active man was compelled to curtail his activities drastically In the past 8 months more definite gastric symptoms appeared principally epigastric pains aversion to food with a loss of several pounds

Ulcer diet and rest were initiated This relieved the distress but not the weakness In the last month, the pain increased despite treatment Repeated

roentgen ray examinations were made over a period of 10 years Although no definite lesion was found the tentative diagnosis of gastric ulcer was made For the last 3 years, a very gradual drawing in of the greater curvature opposite the angulus was observed, interpreted as a spasm Review of all films at the time of examination showed a filling defect on the greater curvature of the lower pole of the stomach the first sign of which had appeared 3 years before, and slowly became more marked

Laboratory examination revealed Hemoglobin 103 per cent, red cell count, 5 500,000, white cell count 8,000, sedimentation rate, moderately increased stools occasionally 1 plus

Gastroscopy carried out on February 20 (Fig 11, frontispiece) revealed a polypoid, nodular, rather sharply defined tumor of the greater curvature of the antrum extending toward the lower pole of the stomach It was not ulcerated The nodes of its surface were of varied size There was a complete atrophy of the gastric mucosa from the cardia to the pylorus The gastroscopic diagnosis was that of a polypoid carcinoma (type I, see below) of the greater curvature of the antrum, which had slowly developed on the soil of a severe atrophic gastritis

At operation March 18, the tumor was found at the area described gastroscopically, and a resection was performed

Pathological examination A polypoid tumor was present 6 by 5 by 15 centimeters in diameter and not ulcerated (Figs 12, 13 14) Microscopically, the tumor showed early malignant degeneration of a gastric polyp, with severe atrophic gastritis throughout the entire operative specimen



Fig. 4 Case 1. Photomicrograph of a section made through the carcinomatous ulcer shown in Figure 3. The ulcer floor consists of a thin layer of carcinomatous tissue the average thickness of which is 0.5 millimeter. At the site indicated by an arrow the growth has penetrated through the muscularis mucosae to a depth of 2 millimeters. The width of the ulcer surface is 8 millimeters.

Reviewing the case history there can be little doubt that the development of a polypoid carcinomatous tumor was preceded by a chronic atrophic gastritis of at least 10 but probably 20 years duration. The histamine refractory anacidity over a period of 10 years was a manifestation of atrophic gastritis. Thus this case supports the theory that carcinoma frequently develops on the soil of chronic atrophic gastritis, a sequence of events which very likely occurred in Cases 1 and 2. The general symptoms of the patient, especially his weakness and incapacity to work, are prominent manifestations of atrophic gastritis. It is questionable whether the very small filling defect present 3 years previously was evidence of a malignant tumor. It is more logical to assume that at first a very small benign tumor developed on an atrophic gastritis, which only recently degenerated into malignancy. Miller Eliason, and Wright (25) reported carcinomatous degeneration in 8 of 23 cases of gastric polyps. An atrophic gastritis was probably the precursor in all, as Miller later recognized (26) particularly evident in their sixth case.

In Case 1, the symptoms leading to gastroscopic examination were due either partly to the presence of an extremely small pyloric carcinoma (weight loss, perhaps), or entirely

to the concomitant atrophic gastritis. In Cases 2 and 3, the relationship between atrophic gastritis and tumor formation is much more obvious, and suggests important conclusions as regards a practical program for the fight against gastric carcinoma.

The histopathological and clinical studies of Saltzman, Konjetzny (20, 21, 22, 23), and Stacmiller indicate a transition from chronic gastritis to carcinoma. Faber concurs with these pathological observations. Clinically, Hurst (13, 15, 16) has argued strongly for this concept. Miller (26), Bloomfield, Usland, Katsch, Kapp, Tuomikoski, and others now agree that in most cases carcinoma develops on the seat of a chronic gastritis.

In 1922 Schindler (33) urged the necessity for examination of patients with minor gastric distress to achieve early diagnosis of malignancy and felt that gastroscopy would be important in this respect. In 1933 (36), he was perhaps the first to advocate periodic examination of patients with precancerous conditions (atrophic gastritis and benign tumors). He maintained that atrophic gastritis can best be recognized gastroscopically, and that gastroscopy permits the diagnosis of small tumors better than roentgen relief technique in some cases.

Katsch's views on the subject of early diagnosis of gastric carcinoma are very important. He believes that the stage of relative latency, with minor uncharacteristic symptoms is the time for early diagnosis. Although he holds x-ray the chief means for this purpose, he recognizes the method is not infallible even in the best of hands and gastroscopy superior in some cases. He therefore urges the wider use of gastroscopy. Since gastritis is the soil for the growth of carcinoma, he feels that the resources and efforts applied to the fight against gastric carcinoma should be used for research on gastritis and careful observation of patients suffering from gastritis even when few or no symptoms are present. Similarly, Miller (26) states that to prevent the development of gastritis and the diseases for which it seems responsible much experimental and clinical investigation is necessary on gastritis. Alessandrini advises the use of gastroscopy as a means of recognizing the precancerous con-

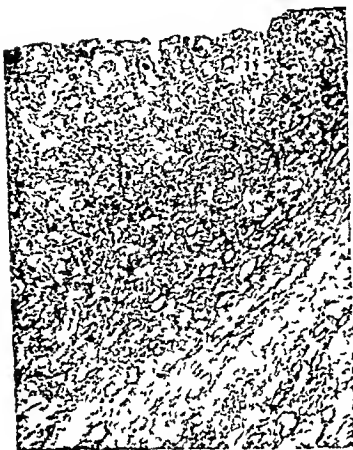


Fig 5 Case 1 Photomicrograph of a section made through the carcinomatous growth shown in Figure 4 with higher magnification $\times 85$



Fig 6 Case 1 Photomicrograph of a section made through the gastric wall adjacent to the carcinomatous ulcer shown in Figures 1 to 5. Severe atrophic gastritis. The gastric glands have almost disappeared. Metaplasia of the surface epithelium into goblet cells. Interstitial infiltration.

dition of chronic gastritis. Presenting 2 cases in which gastric carcinoma developed following chronic gastritis, Comfort and Butsch state that if it is accepted that chronic gastritis is the soil in which carcinoma develops in a large percentage of cases, it will greatly affect the methods used in the prophylaxis and early diagnosis of carcinoma, and that gastroscopy may become most important for this purpose, since a growth may be in its precarcinomatous state or too small for demonstration by x ray.

Kapp analyzed 120 cases of gastric carcinoma as to the early symptomatology, with startling results. Gastric symptoms were present at least 5 years before the diagnosis of carcinoma was made in 12 of 66 cases of pyloric carcinoma, and in 24 of 29 cases of body carcinoma. In another series of 157 cases diagnosed clinically as gastritis, 21, or 13.4 per cent, developed carcinoma in 5 years or later, which incidence is about three times that of gastric carcinoma in general. Kapp

concludes from his statistical study that to effect an early diagnosis, cases of chronic gastritis should be given more attention, and that periodic gastroscopic examinations should be done.

Usland made similar observations in a study of 94 patients operated upon for gastric carcinoma, and 120 with diagnosis of gastritis. In the 94 cases with operations, 26, or nearly 28 per cent, had suffered from dyspeptic symptoms more than 5 years prior to clinical manifestations of carcinoma, such symptoms having been interpreted as due to chronic gastritis. In 120 patients over 30 years of age, who, when first seen during 1922 to 1929 had suffered from symptoms of chronic gastritis for at least 2 years, he found that 18, or 15 per cent, had developed gastric carcinoma in the course of years.

These statistics of Kapp and Usland coincide and are very significant. It is hoped that in the future such studies will be based on the more accurate gastroscopic diagnosis of gastritis. There is strong evidence that the diagnosis of early carcinomas may be made by finding them incidentally in the re-examination of patients with precancerous conditions. *If we wait until the tumor itself produces symptoms, we cannot hope to diagnose a carcinoma of minimal size.*



Fig 7 Case 2 Two roentgenograms made at different institutions. The apparent pyloric filling defect shown in a left is artificially produced by the pressure of the pine. The actual tumor lying much higher on the posterior wall of the mid portion near the greater curvature was not demonstrated by either examination.

The 3 cases of early diagnosis of gastric carcinoma which have been presented suggest the following conclusions:

1 Any patient in the carcinoma age (over 35) suffering from unexplained minor epigastric distress should be examined by the roentgen relief method and gastroscopically.

2 Precancerous conditions, such as chronic atrophic gastritis and benign gastric tumor should be diagnosed by gastroscoping every patient suffering from mild gastric symptoms, or the general symptoms of atrophic gastritis (weakness, loss of weight, etc.).

3 When these diseases are found periodic roentgen and gastroscopic examinations should be made. Only then can small carcinomas be discovered.

GASTROSCOPY IN THE DIFFERENTIAL DIAGNOSIS OF BENIGN GASTRIC ULCER AND MALIGNANCY

The differential diagnosis of benign and malignant gastric lesions can usually be made gastroscopically. It has occurred even in such cases in which examination of the gross specimen gave an uncertain diagnosis. This statement puzzles the pathologist but the reason as mentioned in the discussion of Case 1 is the presence of circulating blood in the living tissues studied gastroscopically. A roentgen diagnosis of carcinoma has been made occasionally when gastroscopy reported a benign lesion. In most of these instances mi-

croscopic examination confirmed the gastroscopic observation. Gutzet and Feige, Schindler (37-38), and Benedict (2) have presented striking cases of this type. The following 3 cases, however, demonstrate roentgenologically benign ulcers in which the gastroscopic diagnosis differed.¹

CASE 4 No 130035. This case has been described elsewhere (38) and shall be mentioned briefly here. A man aged 71 years complained of gnawing epigastric distress after meal for 3 years with relief by food and alkali. The gastric contents after histamine revealed free acid (28) after 30 minutes. Stools gave a negative to 4 plus reaction for occult blood. Seven roentgen examinations were performed from June 17 to October 31, 1935 and the impression was that of a large penetrating ulcer of the cardiac end of the lesser curvature. The third and fourth examinations showed the crater becoming smaller during ulcer management (Fig 15). The first gastroscopy was done June 22, 1935 shortly after the first x-ray study and a diagnosis of an ulcer like carcinoma of the lesser curvature was made because of a grayish ridge like prominence arising from the large crater which was filled with blood coagula.

A second examination made on July 8 confirmed the diagnosis of carcinoma since the ulcer was situated on an elevated area and one part of its edge was not sharply defined. Since the lesion was limited toward the cardia and progressive toward the pylorus radical operation appeared possible. Surgery was performed when x-ray concurred in the diagnosis of carcinoma and an ulcerating carcinoma of the lesser curvature was resected (November 4).

The histological picture is reported by W. L. P. in a J. L. F. report.



Fig. 9 Case 2 A portion of the resected specimen showing a small ulcerated carcinoma

This case demonstrates well the value of gastroscopy in differentiating between a benign and malignant lesion of the stomach. The history and roentgenogram suggested a benign lesion. The gastroscopic diagnosis, however, was definite at the first examination. The fact that the niche became smaller in roentgen examination is important. This phenomenon also occurred in Cases 5 and 6.

CASE 5 No 164708 A man aged 65 years, seen November 30, 1936, suffered from epigastric pain unrelated to meals for 1 year with a loss of 20 pounds. Ulcer management for the next year gave partial relief. In September, 1938, hematemesis occurred, with increase in severity of the pain. Physical examination was non-contributory. Laboratory examination showed a secondary anemia, occult blood in the stools, and free acid in the gastric content (17).

Roentgen ray examination made on December 21, 1936, showed a large questionable ulcer on the posterior wall near the cardia. Re-examination was advised. (The first gastroscopy, December 23, 1936, suggested a malignancy.)

On January 27, 1937, a gastric ulcer was observed on the posterior superior wall, which had decreased slightly in size since the previous examination. On April 13, the ulcer crater near the cardia appeared much larger. The possibility of a neoplasm was not ruled out. On October 23, one or both of the irregular puddles of barium seen in the floor of the gastric shelf were interpreted as ulcer craters.

The first gastroscopic examination, made December 23, 1936, was difficult, because the visual field was partially obscured by fresh blood. On the posterior wall a very large and deep ulcer was seen, with grayish white floor. Parts of the edge were covered by blood. The inferior ulcer edge seemed



Fig. 10 Case 2 Photomicrograph of a section made through the carcinoma seen in figures 8, frontispiece and 9. Adenocarcinoma $\times 100$

rather sharp, but superiorly the edge appeared to blend with the surrounding mucosa. The impression was that of a large deep ulcer of the upper posterior wall, more likely a malignancy. But re-examination was advised before a definite diagnosis was made, owing to the interfering hemorrhage present.

Further roentgen examinations and the clinical course were more suggestive of a benign ulcer, especially since the ulcer niche at one time appeared smaller. For these reasons and because of an intervening urological condition, the patient was not referred for gastroscopy until 10 months later (October 20, 1937). This examination was impossible, however, because of an organic obstruction at the cardia.

At operation November 9, 1937, an inoperable carcinoma of the stomach was found, high on the posterior surface of the stomach, encroaching on the lesser curvature and involving the esophagus.

Gastroscopy suggested a malignancy in this case almost 1 year before operation, although a definite diagnosis was not permitted because of a partially obscuring hemorrhage. The gastroscopic observation of a partial blending of the ulcer edge with the surrounding mucosa could not be reconciled with a diagnosis of



Fig. 12. Case 3. Photomicrograph of a section through an edge of tumor seen in Figure 11 (frontal piece) showing the gradual transition of atrophic gastric mucosa into tumor tissue. The completely atrophic gastric mucosa present on the left side undergoes malformation and proliferation in the center of the picture. The proliferation develops into tumor formation at the right of the picture.

benign ulcer. Here, again, the niche of a malignant ulcer was seen to diminish in size during roentgen study.

CASE 6. No 16202. A man aged 54 years, seen October 16, 1936, complained of epigastric distress radiating to the back, 1 to 2 hours after meal for 2 months. Milk and alkali gave relief. Hematemesis of severe degree had occurred three times in the previous year. Weight loss was considerable.

Physical examination disclosed marked pallor and weakness.

Laboratory examination, October 16, 1936, revealed hemoglobin 20 per cent, red cell count 2,400,000, stools occasionally positive for occult blood. Gastric analysis revealed free acid (195) 50 minutes after histamine. In January, 1937, hemoglobin was 95 per cent, red cell count 4,000,000, stools occasionally positive for occult blood. In September, 1937, hemoglobin was 65 per cent, red cell count 4,000,000. One stool of many showed occult blood. Gastric contents contained free acid

(30) fasting and (195) 40 minutes after histamine injection.

Twelve roentgen ray examinations were performed from October 1936 to September 1937 (Fig. 16) observing the course of a large penetrating ulcer high on the lesser curvature and of a second ulcer developing in the antrum during the course of therapy for the higher ulcer. A marked gastritis was diagnosed surrounding the lesser curvature ulcer. The lesions were believed to be benign ulcers because of their rapid change in size. The upper ulcer crater was large and penetrating in October 1936 but appeared to be healing rapidly on November 10, 1936. The prepyloric ulcer observed on January 10, 1937, had disappeared on February 3, 1937. The upper ulcer had increased in size in April 1937. On September 10, 1937, again both ulcers were seen. Marked enlargement of the rugae was noted several times and the possibility of a malignant infiltration was sometimes considered.

In nine gastroscopic examinations from October 28, 1936, to September 17, 1937, an ulcer was never seen but a tremendous infiltration of the entire gastric wall with loss of plasticity was observed of a type never accompanying benign ulcer (Fig. 17, frontal piece). Stiff, elevated folds and nodes were prominent which suggested either infiltration by tumor or by an unusually severe and rare form of gastritis. Other rare infiltrative lesions were also considered, such as lymphoblastoma and Hodgkin's disease. A definite diagnosis could not be made. Finally a narrowing of the cardia was observed and gastroscopies were discontinued.

Clinical course. The clinical impression of gastric ulcer was supported by the response to ulcer treatment and the roentgen findings. The patient remained well controlled until August 1937 when mild epigastric distress, weakness, loss of weight and appetite recurred. Abdominal aches and a firm mass within a left inguinal hernia were observed September 2, 1937. Exploration of the hernial sac and biopsy of the thickened peritoneum within September 20, 1937, showed carcinoma, believed metastatic from a gastric colloid carcinoma. The patient grew progressively weaker and expired in February 1938.

Autopsy was performed in February 1938. A diffusely infiltrating carcinoma of the entire stomach was found with widespread peritoneal metastases. Inspection of the mucosal surface, however, was misleading since it appeared rather smooth and flat. An ulcer was present on the lesser curvature with fixation to the pancreas. Microscopically (Fig. 18) the entire stomach showed diffuse infiltration by solid and particularly colloid-forming carcinomatous nests. The surface of the ulcer was lined by tumor tissue. Its base showed extensive fibrosis.

It was difficult gastroscopically to differentiate definitely between an unusually severe hypertrophic gastritis and other infiltrative



Fig 13 Case 3 Photomicrograph showing the area of atrophic gastritis present in Figure 1* under greater magnification. Almost complete metaplasia of the epithelium into intestinal epithelium. decrease in the number of glands and interstitial cellular infiltration. $\times 55$



Fig 14 Case 3 A higher powered view of the edge of the tumor seen in Figure 12. At the left metaplastic gastric mucosa can be seen. In the center and to the right of this illustration formation of regular adenomatous tubules into tumor are observed.

lesions, including carcinoma. However, a benign ulcer was excluded. We have never seen such extensive infiltrative changes accompanying a benign ulcer. The patient was well controlled for 8 months following the first examination, and roentgen studies tended to confirm the clinical diagnosis of a benign ulcer. Gastroscopecally the ulcer was not visualized, but the picture seen at the initial examination was in accord with the autopsy findings of a tremendous diffuse infiltrative process of the entire gastric wall. The failure to see the ulcer may be attributed to an overlapping infiltrated fold, or a location in the gastroscopic "blind strip" of the posterior wall.

The difficulty in differential diagnosis between severe diffuse hypertrophic gastritis and other diffusely infiltrating processes, such as carcinoma, lymphoblastoma, Hodgkin's disease, syphilis, has been experienced on

several occasions by Schindler, in 10 of 2,000 patients (38), Moutier (28), and Benedict (2, 3). However, the diffusely infiltrating carcinoma is by far the most frequent of such lesions, and must be strongly considered until definitely ruled out.

It might be argued here that a benign ulcer underwent malignant degeneration. However, the diffuse infiltrative changes were observed early gastroscopically (16 months before death), retrospective evidence of the presence of carcinoma at that time. This case illustrates again the danger of utilizing the roentgen diminution in size of the niche as an argument against malignancy.

Cases 4 and 5 demonstrate that although an ulcer may appear benign clinically and by roentgen ray study (decrease in size of the niche, etc), gastroscopy may enable one to make a positive diagnosis of malignancy at the initial examination. In our experience,



Fig. 15. Case 4. Roentgenograms made in June and July, 1935, respectively, of a malignant ulcer. Because of the decrease in size of the niche a benign ulcer was assumed. The gastroscopic picture and the pathologic examination revealed a carcinoma.

the finding of such an extensive infiltrative process as in Case 6 warrants a presumptive diagnosis of malignancy. It is obviously wrong to assume that a niche is produced by a benign ulcer because it becomes shallower during roentgen ray observation of a few weeks. Bloomfield has described similar cases. Much valuable time may be lost by relying on this therapeutic test. Secondly without gastroscopic observation in these 3 cases the development of carcinoma from benign ulcer might be assumed because of the long history, clinical picture and roentgen ray findings. Gastroscopy, however, revealed the presence or evidence of carcinoma at the earliest stage of observation. It is conceivable that similar cases have been described in the literature as examples of carcinoma developing from ulcer. Early gastroscopy in these cases had this method of investigation been used might have altered this belief.

GASTROSCOPY IN DETERMINATION OF OPERABILITY

Most gastroscopists agree that the method is important in the determination of operability, site and extent of gastric carcinoma. Exploratory laparotomy for determination of operability may be avoided in most cases by

gastroscopy, although other factors may also determine this (general condition of the patient, presence of metastases). We believe gastroscopy superior to roentgen ray examination in this respect. No surgeon considers exploratory operation satisfactory when the condition proves inoperable. It should be done only in those relatively few cases in which the operability is not definitely determined gastroscopically. This should lower the surgical mortality and dispel the unfortunately common belief in the futility of surgical treatment of gastric carcinoma.

We have found Borrmann's classification of gastric carcinoma according to the macroscopic appearance to be the most practical in rendering a prognosis. This classification corresponds completely with the gastroscopic observations.

Type I polypoid carcinoma. This type is sharply limited, operable and gives an excellent prognosis. It occurred in 7.9 per cent of the carcinomas observed gastroscopically by Schindler.

Type II non infiltrating carcinomatous ulcer. This lesion is surrounded by a sharply limited wall, is common and gives a good prognosis. It was found in 17.6 per cent of carcinomas.



Fig 16 Case 6 Roentgenograms of a malignant ulcer the niche disappearing during observation a made October 7 1936 shows a large niche at the upper portion of the lesser curvature In b made June 25 1937, the niche has become very small In c made August 13 1937 the niche has disappeared

Type III, infiltrative carcinomatous ulcer This tumor is only partially surrounded by a limiting wall If operable, the prognosis is still doubtful It occurred in 16.3 per cent of carcinomas

Type IV, diffuse infiltrating carcinoma, which may be ulcerated but little It almost always gives a bad prognosis, and even if resectable, goes on to early recurrence and metastases It occurred in 63.2 per cent of carcinomas

The usual criteria of operability have been whether the tumor can be excised *in toto*, the resection being done in non cancerous tissue, and there is no evidence of widespread metastases The surgeon has no other criteria during the operation, if there is no preceding gastroscopic examination to distinguish the type of tumor present, according to the Borrmann classification In our experience, as judged by the end results, the type has played an important part in the ultimate course Gastroscopy is the best method for determining the type of carcinoma before operation, thus indicating the prognosis In cases of minimal sized carcinomas, the prognosis of this classification should be disregarded for practical purposes It is to be hoped that carcinomas of very small size will give a good prognosis regardless of their type Carcinomas involving the cardia have not been included in the types described, since

the surgical approach is relatively recent, and there has been insufficient time to determine the end results

Even with the usual criteria of operability, gastroscopy is of value, as will be shown in the cases following

CASE 7 No 640 887, Cook County Hospital: A man aged 68 years, seen July 1, 1937, complained of growing epigastric distress for 8 months with a loss of 21 pounds in 1 year Physical examination revealed a poorly nourished male, with slight tenderness surrounding the umbilicus Gastric contents contained no free acid after an 12 hour meal



Fig 18 Case 6 Photomicrograph of a section made through a carcinomatous ulcer Not only the entire ulcer floor but also the gastric mucosa is infiltrated with carcinoma

We are grateful to Dr M Hubeny for his co-operation

Roentgen ray examination July 8 1937 revealed a constant irregularity along the greater curvature of the pars media and pars pylorica which was apparently intrinsic and compatible with a diagnosis of carcinoma

Gastroscopy July 5 disclosed a type II sharply demarcated carcinoma in the antrum its upper margin lying at the level of the angulus

Operation was done July 10 A large ulcerated lesion was found with the infiltration extending upward throughout the entire wall of the stomach almost up to the cardia A very high subtotal gastrectomy was performed

Pathological examination The senior author thought the gross specimen showed almost complete carcinomatous involvement In the region of the lesser curvature near the pyloric end and extending anteriorly was a firm mass $6\frac{1}{2}$ by 6 centimeters The gastric wall appeared thickened throughout the body Microscopic examination revealed a colloid carcinoma in the region of the pylorus and lesser curvature No tumor cells were found in the thickened wall of the body The infiltration present there was inflammatory in character

This case proved to be a type II carcinoma and confirmed the gastroscopic diagnosis as to site and operability Roentgen ray examination indicated higher carcinomatous involvement and the gross examination seemed to confirm this However microscopic examination showed this apparent involvement due to inflammation As the surgeon stated a more dangerous higher resection was therefore performed than if the gastroscopic limitation of the tumor had been accepted This case bears out the statement made with respect to Case 1 that the gastroscopic appearance of a lesion is occasionally superior to the surgical and gross observation, and second only to the microscopic examination

CASE 8 No 118747 (described in detail elsewhere) A man aged 75 years had epigastric distress for 1 year which was relieved by food There was gastric acidity and blood in the stools Roentgen ray examination revealed a penetrating ulcer of the lesser curvature with carcinomatous infiltration The roentgenologist thought the extreme cardiac end of the stomach was not involved but the examination was difficult because the patient could not relax Gastroscopically the tumor involved the lesser curvature anterior wall greater curvature and the cardia The patient expired five months later

In this case, gastroscopy showed the definite inoperability of the carcinoma and contemplated surgery was abandoned In contrast operability was correctly determined in

the preceding Case 7 by the finding of a sharply limited tumor Other such cases have been reported (37)

GASTROSCOPY AS A COMPLEMENTARY METHOD TO X RAY

Gastroscopy cannot replace the x ray in the study of gastric pathology The two methods should not be considered competitive but as complementary procedures (Juras Rigler Schatzki, Templeton, 39) Roentgen ray examination may be superior to gastroscopy in the diagnosis of an early small carcinoma situated in the so called blind gastroscopic areas This is probably rare since we have never seen such a case However we were not able to see a carcinoma observed roentgenologically which had produced an hour glass formation The gastroscopy entered the upper "bag" only and the tumor itself was not seen In a case of previous gastric resection prolapse of the jejunal mucosa into the stomach obscured a recurrent carcinoma which was diagnosed roentgenologically With very refined roentgen relief technique using spot machines the incorrect diagnosis of a very small carcinoma may occasionally be made and gastroscopy may be able to rectify this error The senior author has seen such cases in Munich

The following two cases of large tumors show the two methods supplementing each other

CASE 9 No 190871 A man aged 42 years seen January 4 1938, had suffered gnawing epigastric distress for 6 months 1 hour after meals Diet and alkali afforded partial relief until December 1937 Since then weakness loss of 4 pounds vomiting and loss of appetite had occurred Physical examination was non contributory Hemoglobin was 78 per cent red cell count 4 500 000 Gastric content revealed lactic acid and no free acid after an 1 wald meal After histamine free acid (25) was present in 1 hour Stools showed 4 plus occult blood

Roentgen ray and gastroscopic examinations were made January 17 A stenosing lesion of the pyloric end of the stomach and duodenal bulb was observed in roentgen ray study The impression was that of a probable peptic ulcer although carcinoma could not be absolutely ruled out However the examination was unsatisfactory and another was advised after aspiration

On January 26 gastroscopy revealed a huge carcinomatous ulcer type III on the lesser curvature

along the angulus, with atrophic gastritis (Fig. 19, frontispiece). The tumor had a limiting nodular wall toward the antrum and anterior wall, but the ulcer edge blended with the neighboring mucosa toward the lesser curvature, indicating infiltration. This infiltration extended upward to 2 to 3 centimeters below the cardia. The surrounding mucosa was atrophic. Operability was questioned, and the prognosis held poor even with a total resection.

Immediately following the gastroscopy, a second roentgen ray examination was made. A diffuse carcinoma of the lesser curvature was diagnosed within which a flat ulcer was present. The growth was thought to extend almost to the esophageal orifice.

Operation on January 31 revealed a large carcinoma on the lesser curvature, extending upward toward the cardia. The tumor was adherent to the transverse mesocolon and pancreas. A subtotal gastrectomy was performed, leaving a small stump of stomach behind, about 2 centimeters on the lesser curvature.

Pathological examination. Microscopically, a carcinoma simplex and extensive atrophic gastritis were observed.

The patient became rapidly weaker and expired May 11, 3½ months after operation.

The first roentgen-ray examination was unsatisfactory and failed to reveal the malignant character of the lesion, which was seen at subsequent gastroscopic examination. A second x ray study confirmed the gastroscopic findings. The extent of involvement, the question of operability, and the ultimate prognosis were well answered by gastroscopy.

CASE 10. No 203949.¹ A man aged 44 years, seen August 13, 1938, had suffered progressively increasing epigastric distress for 3 to 4 years. Beginning February, 1938, relief was obtained occasionally by induced vomiting. During the course of the illness, duodenal drainages were performed without improvement, a gall bladder lesion being suspected. Roentgen ray examinations in January 1937, and in May, 1938, were negative. But on August 1, 1938, a defect was thought to be present on the greater curvature of the antrum and a carcinoma was suspected. Gastric analysis showed the presence of free acid (20). Stools were occasionally positive for occult blood.

Gastroscopy (August 13, 1938). The pylorus was seen as a rigid dark hole. At the anterior wall of the antrum, separated from the pylorus by a small bridge of stiff mucosa, a large, round ulceration was seen. Its floor was a dirty gray. The edges were not entirely sharp. There was extensive infiltration along the lesser curvature and upper posterior wall. A

definite demarcation was observed only on the anterior wall. Atrophic changes were seen at depth II (body). The diagnosis was that of a type III large carcinoma. Resection was considered technically possible, but the final prognosis held unfavorable.

Operation (August 20). On the lesser curvature of the stomach, extending up toward the cardia, an ulcerating carcinoma was present, approximately 2½ inches in diameter. Several involved lymph nodes were found along the lesser curvature. The liver appeared free of metastases. A high subtotal gastrectomy with entero-enterostomy was performed.

Pathological examination. Occupying the anterior stomach wall, and extending from the greater to the lesser curvature, was an ulcerated carcinoma, 5 by 2 centimeters, infiltrating the muscle wall and penetrating the serosa. Microscopically, there was an infiltrating ulcerated adenocarcinoma, with involvement of lymph nodes. Atrophic gastritis, with metaplasia of epithelium, was prominent.

The symptoms present in this patient 3 to 4 years before examination seem to us to have been due probably to an atrophic gastritis. At the onset of induced vomiting, 6 months before gastroscopy, a carcinoma was very likely present. Roentgen ray studies, made at a time when the tumor was certainly present (May, 1938), failed to reveal any disease. There is little doubt that the presence of a carcinomatous lesion would have been recognized gastroscopically without difficulty at that time, since the location of the lesion was one easily seen in gastroscopy, as was demonstrated in Cases 1 and 3, with gratifying results. Even shortly before gastroscopy, when an extensive lesion was present, the roentgen ray findings were strongly suggestive, but not conclusive, of carcinoma. Gastroscopic examination settled any doubt as to the character of the lesion. Had gastroscopy been performed at the onset of symptoms, an atrophic gastritis might have been observed, periodic examinations advised, and the carcinoma perhaps discovered at an early stage.

SUMMARY AND CONCLUSIONS

1. Ten cases are presented to demonstrate the importance of gastroscopy in the diagnosis of gastric carcinoma. In 2, Cases 1 and 2, an early diagnosis was made, only gastroscopically, and in one of these the carcinoma was 8 by 2 millimeters in size. Two, Cases 2

We are grateful to Dr. A. A. Goldsmith, Chicago, for referring the patient and to Dr. A. A. Berg, New York City, for the operative report and pathological material.

and 10 showed the long developmental history one of a small carcinoma (Case 3) the other of a large carcinoma (Case 10) the diagnosis being made conclusive by gastroscopy in both. In 3 Cases 4, 5 and 6 gastroscopy was important in the differential diagnosis between benign and malignant ulceration. Two Cases 7 and 8 show the value of gastroscopy in the determination of operability. All show the need for co-operation between roentgenologist and gastroscopist.

2. Early diagnosis of gastric carcinoma may be possible if each patient over 35 years of age who suffers from mild digestive symptoms or loss of weight otherwise unexplained is examined roentgenologically and gastroscopically without delay. This is illustrated by Case 1.

3. The pathological concept that gastric carcinoma in most cases develops on the soil of chronic gastritis is corroborated clinically in Cases 1, 2 and 10 and especially in Case 3 in which no other sequence of events seems probable. Atrophic gastritis is evidently a precancerous condition and should be diagnosed. Except in such conditions as pernicious anemia this can only be done gastroscopically.

4. Patients suffering from atrophic gastritis should be examined by roentgen ray and by gastroscope at regular intervals regardless of symptoms. A carcinoma producing symptoms is usually not of minimal size particularly in the body of the stomach. The silent small carcinoma of Case 2 found in a patient with pernicious anemia and atrophic gastritis would very likely have been discovered gastroscopically when it was one half its actual size. In Case 3 a still earlier diagnosis might have been made if this rule had been followed. Therefore *minimal sized carcinomas may be found only by the routine periodic examination of patients with precancerous states*. Case with repeated negative x ray studies demonstrates that gastroscopy may be an important additional procedure where the roentgen ray results are negative or doubtful. Benign gastric tumor which probably is related to atrophic gastritis is also a precancerous condition and such cases should be observed similarly. (See remarks following Case 3).

5. An apparently benign gastric ulcer should be examined gastroscopically before medical treatment in patients over 35 years of age since the malignant character of the ulcer may then be observed. During the course of treatment the niche may become smaller during roentgen ray observation, even though the lesion is malignant. The common belief that this decrease in size of the niche is evidence against malignancy is wrong as demonstrated in Cases 4, 5 and 6.

6. Gastroscopy has proved superior to roentgen ray examination in determining the operability of certain cases. In Case 7 operability and favorable type were observed in contrast to the roentgen ray and even surgical findings. In Case 8 inoperability was definitely shown. Routine pre-operative gastroscopy may frequently eliminate exploratory operations for this purpose.

7. The gastroscopic picture has been found more characteristic than that of the gross specimen in 2 cases owing to the presence of circulating blood. Only microscopic examination confirmed the important gastroscopic detail observed in Case 1 as to the malignant nature of the lesion in Case 7 as to the operability.

8. Gastroscopy and roentgen ray examination are not competitive but each supplements the other. Close co-operation between the gastroscopist and roentgenologist is essential as existed in the presented cases.

BIBLIOGRAPHY

1. ALESSANDRINI P. Peut-on admettre pour l'estomac un état précancéreux. II Congr. internat. de gastro-entérol. (see refer 9) 1937 p. 63.
2. BENEDICT E. M. Gastroscopic observations in neoplasia. New England J. Med. 1936 214 563.
3. Idem. Importance of gastroscopy in surgical diagnosis. Am. J. Surg. 1938 40 5.
4. BLOOMFIELD A. L. Early carcinomatous changes in peptic ulcer. J. Am. M. A. S. 1935 204 1197.
5. BORRMAN R. In Henke Lubarsch Handb. d. pathol. Anal. u. Histol. vol. 4 part 1 p. 465. Berlin Springer 1926.
6. CHEVALIER R. Le diagnostic gastroscopique précoce du cancer antro-pylorique. J. d. med. de Lyon 1936 17 719.
- Idem. Le diagnostic précoce du cancer de l'estomac par la gastroscopie. II Congr. internat. de gastro-entérol. (see refer 9) 1937 p. 556.
7. COMFORT W. W. and BURSCH W. L. How long does it take for a large carcinoma of the stomach to develop. Report of two instructive cases. Proc. Staff Meet. Mayo Clin. 1938 13 151.

- 9 Deuxieme congres de la societe internationale de gastro enterologie Bruxelles 1937
- 10 IABLER, KNUD Gastritis and Its Consequences New York Oxford University Press 1935
- 11 GUTZIT K., and TEITGE H Die Gastroskopie Lehrbuch und Atlas Berlin and Vienna Urban & Schwarzenberg 1931
- 12 HENNING N Die Fruehdiagnostik d Magenkarzinoms Gastroskopie und Gastrophotographie II Congr internat de gastro enterol (see refer 9), 1937 p 427
- 13 HURST A I Schorstein Lecture Precursors of Carcinoma of the Stomach Lancet, 1929 2 1023
- 14 Idem Achlorhydria and achylia gastrica and their connexion with the Addison's anemia—subacute combined degeneration and simple (non Addisonian) achlorhydric anemia Quart J Med, 1932 25 157
- 15 Idem Alvarez Lecture Unity of Gastric Disorders Brit M J, 1933 2 89
- 16 Idem Harvian Oration The Time Has Come Lancet 1937 2 949
- 17 JUTRAS, A L association du gastroscope et des rayons X dans les affections de l'estomac Clinique 1937 32 57
- 18 KAPP H Zur Bedeutung der Anamnese de Magenkarzinoms II Congr internat de gastro enterol (see refer 9) 1937 p 592
- 19 KATSCH G Fruehdiagnostik des Magenkarzinoms vom Standpunkt des inneren klinikers II Congr internat de gastro enterol (see refer 9) 1937 p 355
- 20 KONJETZNY G E Ueber de Beziehungen der chronischen Gastritis mit ihren Folgeerscheinungen und des chronischen Magenukulus zur Entwicklung des Magenkrebses Beitr z klin Chir 1913 85 455
- 21 Idem Beziehungen der chronischen Gastritis zum Magenkarzinom Verhandl d deutsch Gesellsch I Chir 43 Kongr 1914
- 22 Idem Chronische Gastritis und Magenkrebs Monatsschr I Krebs 1934 2 65
- 23 Idem Wege zur Fruehdiagnose des Magenkarzinoms II Congr internat de gastro enterol (see refer 9) 1937 p 517
- 24 KRECKE A Beitr z prak Chir 1923 to 1926 Munich Lehmann 1929
- 25 MILLER T G ELISON E L and WRIGHT, V W Carcinomatous degeneration of polyp of the stomach Arch Int Med 1930 46 841
- 6 MILLER T C Gastritis in its relation to other diseases Am J M Sc 1933 186 192
- 27 MOIRSCH H J, and SMITH A M Gastroscopy in the diagnosis of gastric disease Am J Surg 1938 39 521
- 28 MOUTIER I Traité de gastroscopie et de pathologie endoscopique de l'estomac Paris Masson et Cie 1935
- 29 Idem La gastroscopie dans le diagnostic precoce du cancer de l'estomac II Congr internat de gastro enterol (see refer 9) 1937 p 193
- 30 KICLER K Gastroscopy and the radiologist Radiology, 1937 28 372
- 31 SALTZMAN I Studien ueber Magenkrebs in des Beruecks d Veränderungen in d Schleimhaut etc Jens T Fischer, 1913 p 135
- 32 SCHATZEL R The comparative value of gastroscopy and roentgen examination of the stomach Radiology 1931 20 488
- 33 SCHINDLER K Diagnostische Bedeutung d Gastroskopie Muenchen med Wchnschr, 1922 69 535
- 34 Idem Lehrbuch und Atlas der Gastroskopie Munich Lehmann 1923
- 35 Idem Gastroscopy in thirty cases of gastric neoplasm Arch Int Med 1923 32 635
- 36 Idem D Bedeutung d Gastroskopie f d Heilung d Magenkrebses Monatsschr I Krebs 1933 2 203
- 37 Idem Gastroscopy The Endoscopic Study of Gastric Pathology Chicago University of Chicago Press 1937
- 38 SCHINDLER R and CIFRI, N Gastric surgery and gastroscopy Arch Surg, 1937, 35 712
- 39 SCHINDLER R and TEMPLETON I Gastroscopic and roentgen findings Radiology, 1937 29 412
- 40 SCHLOSS J LITINGER A IRATT J H Diagnosis of diseases of the stomach by gastroscopic and x ray rehel studies Am J M Sc, 1937 193 171
- 41 STALMUEER Ueber Fruehformen des Magenkarzinoms II Congr internat de gastro enterol (see refer 9), 1937, p 461
- 42 TOMIKOWSKI V Gastritis and carcinoma Acta chirurg Scand 1936 78 251
- 43 USLAND O Ueber d Bedeutung d chron Gastritis f d Entwicklung d Magenkrebses Acta chirurg, Scand, 1935, 6 483
- 44 WASILBERG R N, and ROZENDAL H M Gastric lesions associated with pernicious anemia Ann Int Med, 1938, 11 2172

CYCLIC CHANGES IN CHROMATIN OF THE NUCLEI OF THE ENDOMETRIUM

RUCKER CLEVELAND Ph D Nashville Tennessee

THE first observations on the lining of the uterus go back as far as Vesalius (48) although no real understanding of the structures and their significance was gained until about the middle of the nineteenth century. Modern investigation may be said to have begun with the work of Coste 1847-1849 who demonstrated conclusively that the uterus is lined with a mucous membrane. The next significant advance was made by Kundrat and Engelmann who in 1873 reported the results of a study of the histological changes associated with menstruation.

In 1896 Westphalen published an extensive article in which he correlated the days of the cycle and the structures in the endometrium but the significance of his observations failed to impress his reading public and perhaps even Westphalen himself. In 1908 Hitschmann and Adler published their paper which was to give new understanding and new impetus to the study of the female sex cycle. As a matter of fact this paper contributed little additional data to the histology of the endometrium as previously recorded but its significance lay in the fact that the authors recognized the cyclic nature of the structures they described. This realization and its emphasis made the paper of Hitschmann and Adler unique in gynecological investigation. The work of Schroeder (77 78 79) within the next few years further served to establish the truth of the concept of Hitschmann and Adler because he constantly referred to their work in his publications which were of wide clinical interest.

In the nineteenth century contemporaneous with studies on the purely anatomical structure of the uterus Dalton and later Leopold published articles correlating the uterine and the ovarian structures although

their correlation was solely temporal and no causal concept was defined. In 1900 Knauer transplanted the ovaries of an animal and the results proved conclusively the endocrine nature of ovarian activity while Fraenkel, Loeb and Corner (74) proved experimentally that the corpus luteum of the ovary is essential for the uterine changes preceding and during the early part of pregnancy. This confirmation of the relationship of the corpus luteum to the uterus preceded by 20 years the establishment of the relationship of the follicle to the endometrium. In 1923 the hormone produced by the follicle was prepared from the follicular fluid and its effect upon the genital tissues was observed. This work initiated by Allen and Doisy in the United States and by Butenandt in Germany, has resulted in a tremendous amount of research in the clinic and laboratory which has proved indubitably that the follicular hormone is responsible for growth of the genital tissues in general (1) and especially of the endometrium (1 20 31 39 34 53 98 108).

The ovarian uterine interrelationship once firmly established has meant, in practical application that the microscopic structure of the endometrium yields accurate information concerning the hormonal activity of the ovary. This is possible because of the specificity of the follicular hormone in producing growth and of the corpus luteum factor in producing secretion (4 20, 25) in the cells of the endometrium.

The ovary for lack of definite proof to the contrary was generally believed to be more or less autonomous until that epoch marking year of 1926 when Smith (87 88) in the United States and Zondek and Aschheim (106 107) in Germany, demonstrated that the ovary is stimulated by substances secreted by the pituitary gland. Even greater volumes of work appeared on the pituitary-ovary relationship on the basis of this work than have



Fig 1 Stomal cells a Granular and non granular form of nucleus represented. The granular nuclei have smooth and irregular contours b Stomal cells from the transitional zone between basalis and spongiosa. Note the solid chromatin in the nuclei on the right which is in the region of the basalis and the granular chromatin in the nuclei on the left. The canals between the cells have been described by Young c Typical basalis region containing the solid homogeneous non granular chromatin in the nuclei of irregular contour

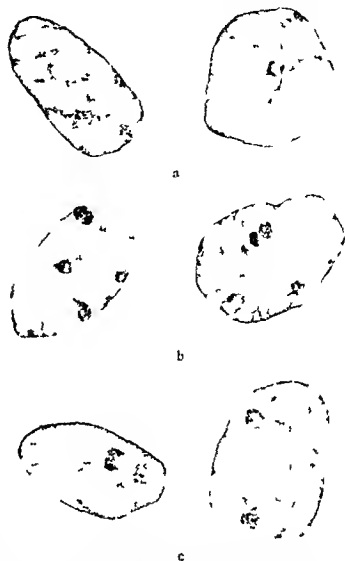


Fig 2 Granular nuclei a Aggregated chromatin. This type of nucleus predominates in specimens of proliferative endometrium. The chromatin particles are aggregated along lines approximating those described for the lumen network. b There are many discrete particles of chromatin scattered through the unstained nucleoplasm in this type of nucleus which is intermediate between the typical aggregate and the typical diffuse type of granule distribution. c, The chromatin particles are distributed diffusely throughout the unstained nucleoplasm. There may be two or more large round or oval areas of solid chromatin present in nuclei of this type. There is little or no hint of the outline of the lumen network.

appeared on the ovarian uterine relationship. As a result of these extensive investigations it has been definitely shown that two specific pituitary factors act upon the ovary (21, 36, 104, 106). The first, and apparently the more fundamental and abundant, is a substance stimulating the growth of ovarian follicles (95, 104), the second, a factor which brings about transformation of the granulosa and thecal cells in the ovary into corpus luteum cells (36, 95, 104, 105). As though this relationship is not sufficiently complicated, it has been further shown that the follicular hormone produced in the ovary as a result of pituitary stimulus, in turn acts back on the pituitary (6, 33, 59, 60, 68, 69, 81) and affects

the amount of follicle stimulating factor released, as well as the amount of the luteinizing factor (30, 35, 51, 100, 101). At least to date no adequate evidence of a uterine hormone has been brought forth to complicate further the interrelationships in solving the *modus operandi* of the sex cycle.

The anatomist and the endocrinologist have demonstrated that the normal function



FIG. 3. a Specimen No. 4029. Showing gland epithelial nuclei which contain aggregate chromatin. 2 mu section. Bouin fixation. Wratten plate. $\times 3000$. b Specimen No.

4640. Showing gland epithelial nuclei which contain diffuse chromatin. 2 mu section. Bouin fixation. Wratten plate. $\times 3000$.

of the sex cycle depends upon the proper balance between ovary and pituitary. But the clinician has contributed no small part of the present knowledge of the uterine cycle. Schroeder (78-79) in 1912 reiterated a previously enunciated concept (11, 18, 28, 43, 76) that pathological endometrial pictures accompanying menstrual dysfunction are the result of ovarian disorders. Confirmation of the role of the ovary in producing the classical picture of glandular cystic hyperplasia (39) came in 1931 and 1932 when Burch and his coworkers (15, 16, 102) produced the condition experimentally. This work subsequently repeated by others (53, 75, 92, 98, 108) has formed a basis for the analysis and therapy of ovarian disorders as manifested by endometrial pathology and menstrual symptoms (13, 14, 19, 20, 54, 55, 96) as well as forming a basis for the experimental reproduction of the various pathological pictures (75, 83, 84, 97).

Repeated studies and investigations of endometrial structure have established certain histological characteristics as criteria in determining the secretory, proliferative or menstrual nature of endometrium. Hitschmann and Adler based their differentiations of the endometrium in the different phases of the cycle largely on gland form and the progressive thickening of the mucosa. Schroeder (77) described cellular and internal cytoplasmic pressure variations during the cycle.

Hitschmann and Adler classified endometrial tissues as characteristic of a postmenstrual phase, an interval phase, a premenstrual phase and a menstrual phase. Schroeder's classification (79) of endometrial tissue was based on the histophysiological characteristics of regeneration and proliferation (corresponding to the temporal phase of postmenstrual and interval secretion (the premenstrual phase), and desquamation (menstruation). The basic characteristics of endometrial structure in the different phases of the menstrual cycle together with the menstrual history, have made possible a knowledge of the successive stages of the development of the endometrium from one menstrual phase to the next. The essential criteria for these stages have been included in the following review of the literature on the histology of the endometrium.

Histology of the endometrium. The lining of the uterus is unique not only because of its periodic desquamation, but also because of the rapidity of its growth and its modification from an essentially proliferative tissue to one that is essentially secretory in nature.

These uterine tissues so responsive to hormonal stimuli consist of an extremely sensitive gland and surface epithelium and a less reactive connective tissue stroma (77, 80) through which blood vessels and lymphatics course. The form of the glands, and of the

cells comprising them, present typical histological pictures characteristic of growth and of secretion. The two outer reactive regions of endometrial tissue are known as the functional layers and the region next the uterine muscle, which is not affected by the cyclic variations of the hormones, is known as the basalis.

Proliferative endometrium (postmenstrual and intercal) The endometrium in the period immediately following desquamation and in the interval preceding ovulation is essentially a growing endometrium. The literature contains many references to and descriptions of postmenstrual, early, mid and late interval types of tissue, with careful observations on the differences between them, but the basic characteristic common to all of these tissues is that of cellular increase by mitotic division. The gland and connective tissue modifications described for the early, mid, and late interval types of endometrium are merely the result of this cell proliferation in varying degrees. The endometrium progressively thickens throughout the period preceding ovulation (50), and there may be a differentiation into the superficial compacta and deeper spongiosa layers (50). The stromal connective tissue is composed of an acellular fibrillar network in the meshes of which lie stellate or spindle shaped connective tissue cells (34, 50, 52, 56, 78, 103). When there is a differentiation into the compacta and spongiosa, the connective tissue cells are more numerous in the compacta, more sparse in the spongiosa (82), while the fibrillar network is more dense in the compacta, and looser meshed in the spongiosa. The lumen of the glands in the compacta is relatively narrow in both the proliferative and secretory phases of the cycle (50). These narrow lumened glands, initially straight from fundus to mouth throughout the depth of the endometrium (50, 74, 99), become somewhat twisted and slightly tortuous in form as the proliferative phase progresses (50, 99). This is true especially in the region of the spongiosa with its paucity of connective tissue cells and wide meshed fibrillar network (80). Mitotic figures are reported in the stroma of postmenstrual and proliferative tissue (50, 56, 70, 99). The glands are

relatively few in number in the period immediately following desquamation (50, 70, 78), and their progressive increase in number is attributed to the growth of buds of epithelial cells from strands of epithelium connecting the fundic portions of the existing glands in the basalis (74). This mode of gland increase by epithelial growth apparently is not limited to the proliferative phase of the cycle since there is histological evidence that the basal buds continue to extend themselves toward the uterine lumen during the secretory phase of the cycle (74, 74b).

The epithelial cells increase so rapidly as a result of the extensive mitosis that the cells are piled upon one another and are pseudostratified (50, 70, 77, 78, 99). The amount of cytoplasm in these cells is slight (70), and there is little histological evidence for secretory activity (50, 70, 80). The cytoplasm is acidophilic (80), with a sharply defined cell membrane (50, 77). Areas of modified cytoplasm or vacuoles may be seen in some cells either beneath or beside the nucleus (50, 77, 78). When secretory products are present in the lumen of glands during the proliferative phase of the cycle, they lie immediately next to the lumen edge of the cell membrane which is sharply defined (50, 70, 77, 78), this appearance is so characteristic for the phase, that such cells are described as type I secretory cells (8). Type I secretory cells may also be seen in tissues secured during the secretory phase of the cycle, but they occur in greater numbers during the proliferative phase (8, 78). The nuclei of the epithelial cells are large and elliptical (50, 70) with sharply staining chromatin (50, 70), they may be basally or centrally located within the cell (50, 77, 82). Large numbers of mitotic figures are present in the epithelium during this phase of the cycle (50, 70, 77, 99).

The scope and purpose of this paper does not appear to justify a discussion of the reports in the literature of the Golgi apparatus (9, 19, 94), ciliated cells (8, 34, 44, 80), glycogen (9, 10, 74, 74b, 80, 91, 97),¹ lipid content (5, 45, 99), and mitochondria (8, 9) since

¹Since the writing of this a paper by Hissaw and Greep has appeared in *Endocrinology* 1918 23 1-14 which contains descriptions of the glycogen content of the endometrium of castrate monkeys following treatment with estrin and progesterin.

TABLE A — CLASSIFICATION BY THE DEPARTMENT OF OBSTETRICS AND GYNECOLOGY OF THE TISSUES EMPLOYED IN THIS STUDY

	No. specimens
1b t l g cally e male i m trum	
Prolif u e pha	7
Secret ry pha e	14
Me strual d y a d a ph e	4
P thol g le d metri m	
W ak proge tin—durst d gr fail e—	
Prolif au e pha	10
Secret ry pha e	30
Me strual d y a d a ph e—h t e y d	
is l x cycle s r m a l e y d h	46
N pr g u —sec d d gree fa lu e—	
Hyperpl	47
Secretory ph	
Me tr al day d ph	0

either secretory proliferative or menstrual characteristics (four were designated as post menstrual), (2) pathological endometrium showing some but not a full effect of the corpus luteum hormone and designated as first degree failure (either menstrual or secretory) and (3) pathological endometrium manifesting an exaggeration of the action of the follicular hormone with no corpus luteum action on the tissue being apparent histologically these latter tissues were hyperplastic in nature and classified as second degree failure.*

A preliminary correlation of the chromatin form in the glands of all secretory specimens whether normal or pathological and of all proliferative tissues whether normal or pathological was made to determine if there was adequate evidence that one type of chromatin appeared consistently in either type of tissue. A second preliminary correlation of the chromatin in day 1 menstrual specimens regardless of normal or pathological structure but grouped according to the length of the preceding cycle was made to determine if cycle length might be a factor upon which structure of menstrual tissues depended. Following this the normal tissues were subdivided into the proliferative secretory, and menstrual groups and analyzed for chromatin form in glands and stroma. These factors were then compared with the same ones in the first degree failure menstrual and first degree failure secretory tissues, as well as in the hyperplastic specimens and in a special group of bleeding specimens. Because of the large number of first degree failure menstrual specimens, the menstrual history was consulted and the specimens divided into those which were sequestered after short cycles after

cycles of normal length, and after lengthened cycles (Table A)

Findings There were two distinct forms of chromatin in the nuclei of the endometrium. It occurred as finely divided particles in a clear nucleoplasm or as a solid homogeneous mass of chromatic material which was irregular in outline and was similar in appearance to that of the nuclei in the basalis region (Fig 1, a, b, and c). These solid homogeneous nuclei have been described in the literature as "pycnotic" (56), and as occurring in greatest abundance in specimens of menstruating endometrium (50, 56).

The granular chromatin (64) was distributed either diffusely or irregularly throughout the clear nucleoplasm. In the diffuse type of distribution, the particles of chromatin were lying equidistant from one another within the nucleoplasm which also contained one or more large round or oval masses of solid homogeneous chromatic material. Nuclei of this type appeared to be pale blue in color, and have been described in the literature as having "fine" (32, 37), or "diffuse" (53) chromatin (Fig 2 c Fig 3 b).

When the granular chromatin was irregularly distributed within the clear nucleoplasm large numbers of these granules were aggregated along lines approximating those described for the linen network.¹ At intervals along this network there were large polygonal areas of discrete chromatin particles. Between the strands of aggregated chromatin there were a few granules lying free in the colorless nucleoplasm. The relationship of the granules of chromatin to the lines approximating those for the linen network resembled that of iron filings to the lines of force created by a magnet. In the literature (37) the term coarse chromatin has been applied to nuclei of this type (Fig 2, a Fig 3, a).

The frequency of mitotic figures was greatest in groups of tissues in which the granular chromatin was aggregated and least in those in which the chromatin was diffusely distributed (Table I, Charts 2, 3, 7, and 8).

*If pe (1894) reported that a n t l is always ee i th n le of the d n tr m re g e t e (be i r v l) prol f r t e g o s t t l est u s t v s. If at t that at t m th u e s o k less pro u n e d i f r e q u e t l y v i s i b l e t w h b t m e r s h c l a r e p l s t n g a n d h a d k s t a m g c l e a t t h b e o f t h c l

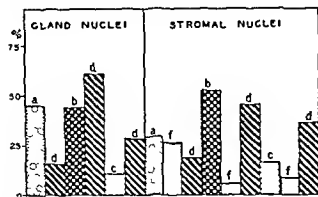


Chart 1. Association of types of granule distribution in nuclei with the presence of solid chromatin nuclei and with the presence of mitotic figures. a. Percentage of 185 specimens having diffuse; b. percentage having aggregate; c. percentage having intermediate type of chromatin; d. percentage average of solid nuclei in stroma of tissues containing the various types of granule distribution based on cell counts; e. percentage of specimens in each group having mitotic figures.

In many specimens the granular chromatin was of neither the typically diffuse type of distribution nor of the typically aggregate but was apparently a variation of one or the other of these two. An analysis of the difference in appearance between these intergrades and the typical diffuse or typical aggregate, revealed that the relative abundance of the discrete particles of chromatin in the colorless nucleoplasm was responsible for the varying appearances (Fig. 2, b).

Gland nuclei. The gland nuclei rarely contained the solid homogeneous form of chromatin, when present, it was in cells which have been described in the literature as "rod" cells. The granular nuclei almost uniformly had smooth even contours, although in some specimens they were somewhat crumpled and irregular in outline.

Stromal nuclei. The stromal nuclei presented a much more varied picture than the epithelial nuclei. Frequently, this could be traced to the presence of large numbers of nuclei with the solid homogeneous type of chromatin, and again, the difference depended upon the relative proportions of nuclei with smooth, and nuclei with crumpled, nuclear membranes. The varying proportions of granular to solid chromatin nuclei, and of smooth contour to irregular contour granular nuclei, furnished a basis for tissue differentiation independent of gland form or menstrual history. The solid chromatin nu-

TABLE 1.—ASSOCIATION OF MITOSIS AND GRANULAR CHROMATIN DISTRIBUTION IN GLAND EPITHELIUM AND OF SOLID HOMOGENEOUS NUCLEI WITH THE VARIOUS TYPES OF CHROMATIN DISTRIBUTION IN THE STROMAL NUCLEI IN 185 TISSUES

Area of tissue	Type of chromatin distribution		
	Diffuse	Intermediate	Aggregate
Gland epithelium			
No. of specimens	83	21	81
Percent mitosis	15.6	28.7	61.7
Stroma			
No. of specimens	56	30	99
Percent mitosis	10.6	36.7	45.5
Percent average of solid nuclei in cells counted	27	0.5	6.6

clei occurred more frequently in tissues containing the diffuse granular chromatin than in those containing the aggregate granules of chromatin (Table 1, Chart 1).

Generally one type of granular chromatin distribution prevailed throughout a single specimen, i.e., in both glands and stroma it was either all of the diffuse or all of the aggregate type of distribution, or all of some uniform intergrade between these extremes. In some tissues there were differences in the type of granule distribution in the compacta and spongiosa layers of tissue.

Too much emphasis cannot be placed upon the fact that these studies on nuclear form were made with the aid of the oil immersion lens, and that the tissues were not previously examined under low or even high dry objectives by the investigator in order that his logical criteria of proliferation and secretion should not in any way influence the necessarily subjective decision as to the character of the nuclei. At the completion of the study, the chromatin form in the gland nuclei, and the occurrence of mitotic figures, were correlated with the nature of the tissue reaction as recorded in the files of the department of obstetrics and gynecology.

PRELIMINARY CORRELATION OF GRANULAR CHROMATIN WITH SECRETORY AND PROLIFERATIVE TISSUES

Gland chromatin in all postmenstrual and proliferative tissues. These tissues were char-

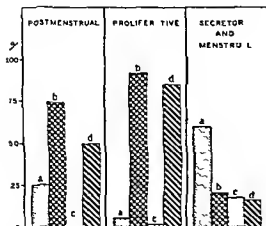


Chart 2. Chromatin granule distribution and mitosis in gland nuclei of specimens of endometrium as classified by the Department of Obstetrics and Gynecology. a. Percentage of specimens having diffuse chromatin in gland nuclei. b. Percentage of specimens having aggregate chromatin in gland nuclei. c. Percentage of specimens having intermediate type of granule distribution in gland nuclei. d. Percentage of specimens in group having mitotic figures in gland nuclei.

acterized by the presence of the aggregate type of granule distribution in the gland nuclei and also by the large number of specimens which had mitotic figures in the gland nuclei (Table II, Chart 2).

Gland chromatin in all secretory and menstrual tissues. Since there were no outstanding differences in the figures compiled on all the specimens pronounced as having secretory characteristics and all those simply listed as menstrual in character the data on these two groups of tissue have been combined and presented in one column. There was a great increase in the number of specimens containing the diffuse type of granular chromatin in the

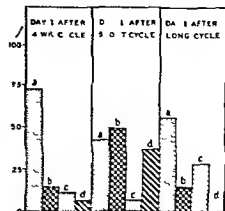


Chart 3. Chromatin granule distribution and mitosis in gland nuclei of day 1 menstrual specimens secured after cycles of different length. a. Percentage of specimens having diffuse chromatin and b. percentage of specimens having aggregate chromatin in gland nuclei. c. Percentage of specimens having intermediate type of granule distribution in gland nuclei. d. Percentage of specimens having mitotic figures in gland nuclei.

gland nuclei in these specimens as compared with those of the proliferative group and there was a marked decrease in the number of specimens containing the aggregate type of granular chromatin. The number of specimens containing mitotic figures in the gland nuclei was much less in the secretory tissues than in the proliferative tissues (Table II, Chart 2).

Gland chromatin in all day 1 menstrual specimens. The day 1 menstrual specimens regardless of the length of the preceding cycle were characterized by the presence of diffuse chromatin in the gland nuclei in the majority of cases. When the tissues were grouped according to the length of the preceding cycle, the day 1 tissues secured after short cycles of 1

TABLE II—CLASSIFICATION OF SPECIMENS ACCORDING TO DEPARTMENTAL RECORDS

Diagnosis	No. of specimens	Granule distribution in gland nuclei			No. of mitoses in gland
		Diffuse	Aggregate	Intermediate	
Postmenstrual	4	1	3		
Proliferative	52	31	48		45
Secretory and menstrual	19	7	5	4	
Unclassified	15				

Day 1 after 1-5 day cycle 34 day cycle
 of these secured on day 1 after 1-5 day cycle 100 bleeding secured

TABLE III—CHROMATIN FORM IN GLAND EPITHELIUM OF 49 DAY 1 MENSTRUAL SPECIMENS AFTER CYCLES OF NORMAL SHORT AND PROLONGED LENGTH

Length of cycle	No. of specimens	Granule distribution in gland nuclei			No. of mitoses in glands
		Diffuse	Aggregate	Intermediate	
Normal length	6	19	4	3	2
Short cycle	15	7	8	1	6
Long cycle	7	4	1		0
Total	28	26	13	4	8

and 2 weeks tended to have the aggregate chromatin more often than the diffuse type, and mitotic figures were present in more tissues of this group than in the ones secured after cycles of average or of prolonged length (Table III, Chart 3)

HISTOLOGICALLY NORMAL ENDOMETRIUM

Twenty five specimens included in this study which were described as having a normal histological structure were secured during a cycle which subsequently proved to be of normal length, and the cycle preceding had been of normal length. The specimens were obtained on the various days of the cycle dating from the onset of the previous bleeding, but the number and distribution of these specimens over the days of the cycle is such that no great significance with reference to cyclic variations can be attached to the observations reported (Table VIII)

Proliferative tissues Gland nuclei Aggregate chromatin and mitotic figures characterized the gland epithelium of these tissues (Table VIII, Chart 7). Two exceptions occurred in specimens secured on days 8 and 10, respectively, the former was described as an interval specimen, the latter as a postmenstrual one. There are several reports in the literature in which "atypical" specimens of endometrium are described (56, 74a, 77), and in some of these reports, the atypical specimens have been discarded in the general review of the findings by these investigators. Although the number of such reports is not great, the dating of the specimens is usually unquestioned, and they should not be dismissed too lightly. **Stromal nuclei** The granular nuclei in the stroma likewise was of

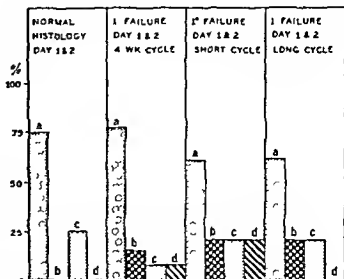


Chart 4. Chromatin granule distribution and mitosis in gland nuclei of normal day 1 and 2 menstrual specimens and of first degree failure day 1 and 2 menstrual specimens as diagnosed by the Department of Obstetrics and Gynecology. a Percentage of specimens having diffuse and b percentage of specimens having aggregate chromatin in gland nuclei. c Percentage of specimens having intermediate type of granule distribution in gland nuclei. d Percentage of specimens having mitotic figures in gland nuclei.

the aggregate type in the majority of instances (Table VIII, Chart 8). There were fewer specimens having mitotic figures in the stroma in the proliferative than in the secretory specimens (Chart 8). There were more nuclei having smooth contours in the stroma of the group of proliferative than in the group of menstrual tissues, but there were fewer nuclei with smooth contours in the proliferative than in the secretory tissues (Table VII, Chart 9). There were few or no solid "pycnotic" nuclei in the stroma of the proliferative specimens, with exception of tissues that did not have the aggregate form of granular chromatin, in these, the numbers of "pycnotic" nuclei were higher (Table VIII)

TABLE IV—FREQUENCY OF OCCURRENCE OF DIFFERENT TYPES OF CHROMATIN IN GLAND NUCLEI OF DAY 1 AND 2 MENSTRUAL SPECIMENS OF NORMAL AND FIRST DEGREE OVARIAN FAILURE PATIENTS

Tissue diagnosis	Length of previous cycle	Days	No of specimens	Chromatin distribution in gland nuclei—per cent			Specimens having mitosis—per cent
				Diffuse	Aggregate	Intermediate	
Normal	av 4 wks	1 & 2	4	75	0 0	25 0	0 0
1st failure	av 4 wks	1 & 2	26	77	15 3	7 7	7 6
1st failure	3 wks & less	1 & 2	13	60	20 0	20 0	20 0
1st failure	5 wks & more	1 & 2	5	60	20 0	20 0	0 0

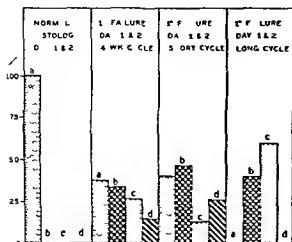


Chart 5. Chromatin granule distribution and mitosis in stroma nuclei of normal day 1 and 2 menstrual specimens and of first degree failure day 1 and 2 menstrual specimens secured after cycles of different length. a. Percentage of specimens having aggregate chromatin in stroma nuclei. b. Percentage of specimens having intermediate type of granule distribution in stroma nuclei. c. Percentage of specimens having mitotic figures in stroma nuclei.

Secretory tissues Gland nuclei. In the secretory specimens the gland nuclei contained the intermediate and diffuse type of chromatin in the majority of the specimens (Table VIII Chart 7) and mitotic figures appeared in many of them. **Stromal nuclei.** In the normal secretory tissues there were fewer specimens with the diffuse type of chromatin in the stroma than in the gland epithelium. More specimens of this group contained mitotic figures in the stroma than in the gland epithelium (Table VIII Chart 8). There were more smooth contour nuclei in the stroma of the secretory tissues than in the stroma of the proliferative or menstrual tissues of the normal groups (Table VIII,

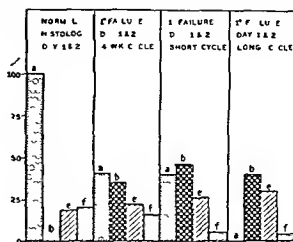


Chart 6. Stroma studies chromatin granule distribution and per cent average of solid nuclei and of granular nuclei with smooth contour in normal day 1 and 2 and in first degree failure day 1 and 2 menstrual specimens secured after cycles of different length. a. Percentage of specimens having aggregate chromatin in stroma nuclei. b. Percentage of specimens having intermediate type of granule distribution in stroma nuclei. c. Percentage of specimens having mitotic figures in stroma nuclei. d. Percentage of specimens having mitotic figures in stroma nuclei.

Chart 9). Tissues secured on sixteenth and twenty third days after onset of previous menstruation contained large numbers of solid homogeneous nuclei in the stroma (Table VIII).

Menstrual day 1 and 2. There was no aggregate chromatin in either the gland or stromal nuclei and no mitotic figures in any of the tissues included in this classification. The nuclei with smooth contours were fewer in number in the stroma of the menstrual tissues than in either the proliferative or secretory tissues while the numbers of solid pycnotic nuclei were greater than in any of the other tissues of the normal group (Table VII Chart 9).

TABLE V.—STROMAL NUCLEI IN DAY 1 AND 2 MENSTRUAL SPECIMENS FROM NORMAL AND 1 OVARIAN FAILURE PATIENTS

Tissue diagnosis	Length of menstrual cycle	Days	Number of specimens	Chromatin distribution in stromal nuclei—per cent			Nuclear form in stroma		Specimens having mitosis—per cent
				Diffuse	Aggregate	Intermediate	Average smooth nuclei	Average solid nuclei	
Normal	4 wks	1 & 2	4	100.0	0.0	0.0	19.0	20.4	0.0
Failure	4 wks	1 & 2	6	33.4	34.7	36.0	22.3	16.3	15.0
Failure	short	1 & 2	5	4.0	46.7	33.3	6.3	5.7	26.0
Failure	long	1 & 2	5	0.0	4.0	60.0	3.4	4.0	0.0

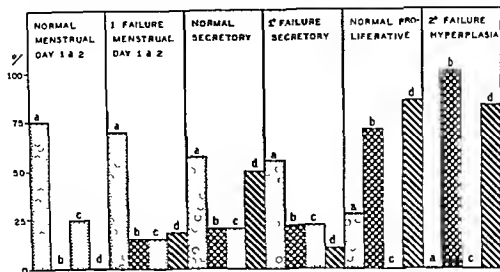


Chart 7 Chromatin granule distribution and mitosis in gland nuclei of normal and abnormal types of endometrium a Percentage of specimens having diffuse and b percentage of specimens having aggregate chromatin in gland nuclei c, Percent age of specimens having intermediate type of granule distribution in gland nuclei d Percentage of specimens in group having mitotic figures in gland nuclei

COMPARISON OF CHROMATIN FINDINGS IN NORMAL AND PATHOLOGICAL ENDOMETRIUM

When the nuclear form and structure in pathological tissues was compared with that of tissues having normal histological structure, the pathological tissues were classified as those showing some secretory characteristics (first degree failure) and those showing no secretory activity (second degree failure). The first degree failure tissues were grouped into day 1 and 2 menstrual for comparison with the normal day 1 and 2 menstrual, and the remaining first degree failure tissues compared with the normal secretory specimens. The second degree failure tissues were grouped for comparison with normal proliferative specimens.

Normal menstrual and first degree failure menstrual tissues When the 4 normal speci-

mens of menstrual endometrium were compared with the 46 first degree failure menstrual tissues, no especially marked differences between the gland nuclei of the two groups could be distinguished, with the exception that there were some of the first degree tissues which had mitotic figures in the gland epithelial nuclei, and a few such specimens with the aggregate type of granular chromatin (Table VI, Chart 7). When the 46 first degree failure day 1 and 2 tissues were subdivided according to the length of the preceding cycle, there was even less contrast between the gland nuclei of the normal and of the first degree failure specimens secured after cycles of approximately 4 weeks (Table IV, Chart 4). There were mitotic figures in the gland epithelium of some of the first degree failure menstrual specimens secured after

TABLE VI—GLAND CHROMATIN DISTRIBUTION IN NORMAL AND PATHOLOGICAL SPECIMENS OF ENDOMETRIUM

Tissue diagnosis	Tissue reaction	No. of specimens	Chromatin distribution in gland nuclei—per cent			Specimens having mitosis—per cent
			Diffuse	Aggregate	Intermediate	
Normal	Menstrual	4	75 0	0 0	25 0	0 0
1 failure	Menstrual	46	69 6	25 2	25 2	18 0
Normal	Secretory	14	57 1	21 4	21 4	50 0
1 failure	Secretory	9	55 0	22 5	22 5	11 0
Normal	Proliferative	7	28 6	71 4	0 0	85 0
2 failure	Proliferative	24	0 0	100 0	0 0	83 0

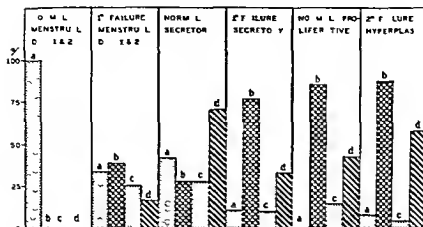


Chart 5. Chromatin granule distribution and mitosis in stroma nuclei of specimens of normal and abnormal endometrium. a Percentage of specimens having diffuse type of chromatin; b Percentage of specimens having aggregate chromatin in stroma nuclei; c Percentage of specimens having intermediate type of chromatin in stroma nuclei; d Percentage of specimens in group having mitotic figures in stroma.

short cycles (Chart 4). The first degree failure menstrual specimens secured after short cycles closely resembled the normal secretory tissues in gland chromatin characteristics with the exception that the mitotic frequency was lower in the former group than in the normal secretory group (Chart 4 column 3, Chart 7 column 3). *Stromal nuclei.* The outstanding contrast between the groups of normal menstrual specimens and the 46 first degree failure menstrual specimens was the lower number of specimens containing the diffuse type of chromatin in the stromal nuclei and the higher number of specimens with mitotic figures in the pathological tissues (Table V, Chart 5). It was interesting to note that although the group of first degree failure tissues after long cycles contained a number of specimens with the

aggregate type of chromatin there were no mitotic figures present in the stromal cell and also there were no specimens of this group with the diffuse chromatin in the stroma (Table V, Chart 5). There were fewer of the solid pyknotic nuclei in the first degree failure menstrual specimens than in the normal menstrual ones (Table V, Chart 6) and more of the granular nuclei which had smooth contours (in the pathological specimens) than there were in the normal tissues (Table V, Chart 6).

Normal secretory and first degree failure secretory tissues. Gland nuclei. Reference to Chart 7 columns 3 and 4 shows at once that the outstanding difference between the normal secretory and first degree failure secretory tissues was the greater number of specimens with mitotic figures in the group of normal

TABLE VII.—STROMAL NUCLEI IN NORMAL AND PATHOLOGICAL SPECIMENS OF ENDOMETRIUM

Tissue group	Type	No. of specimens	Chromatin distribution in stromal nuclei			Nuclei from stroma		Specimens having mitotic figures
			Diffuse	Aggregate	Intermediate	Amorphous	Angular	
Normal	Menstrual	4	100	0	0	90	10	0
1st Failure	Menstrual	46	34.8	39	0	49	13.4	17.0
Normal	Secretory	4	4.8	56	36	45	6	20
1st Failure	Secretory	9		77	0	45.6	0	33
Normal	Proliferative	7		85.6	4.4	38.5	50	43.0
2nd Failure	Proliferative	4	8.5	87.5	4.1	6.5	77	58.0

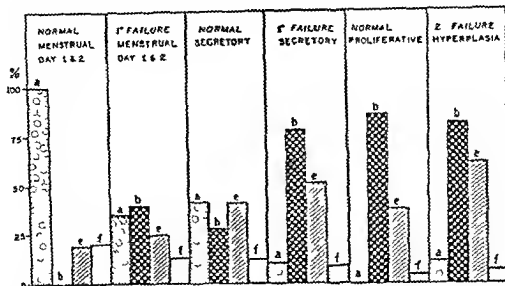


Chart 9. Stroma studies: chromatin granule distribution and per cent average of solid nuclei and granular nuclei with smooth contour in normal and abnormal specimens of endometrium. a Percentage of specimens having diffuse and b percentage of specimens having aggregate chromatin in stroma nuclei. c Per cent average of granular nuclei with smooth contours in stroma of specimens in the group based on cell counts. f Per cent average of solid chromatin nuclei in stroma of specimens of group based on cell counts.

tissues. *Stromal nuclei*. The stromal nuclei in the pathological specimens were predominantly of the aggregate type of granule distribution, although the number of specimens with mitotic figures in the first degree failure tissues was about half of that in the normal secretory tissues (Chart 8). In the pathological stroma there was a higher percentage of nuclei with smooth contour than in the normal secretory tissue (Table VII, Chart 9).

Normal proliferative tissues and hyperplastic endometrium. Gland epithelium. The aggregate type of chromatin predominated in normal proliferative tissues, the exceptions being due to the presence of the day 8 and 10 specimens, mentioned previously. Most of the normal specimens contained mitotic figures. The hyperplastic specimens uniformly had the aggregate type of chromatin in the gland nuclei and each contained mitotic figures (Table VI, Chart 7). *Stromal nuclei*. The stromal nuclei, in both the normal and pathological proliferative tissues, likewise exhibited the aggregate type of granule distribution in a large percentage of the cases (Table VII, Chart 8). There were fewer specimens with mitoses in the stroma than in the gland epithelium in both groups of tissues (Chart 8), although the hyperplastic group contained more specimens with mitoses than did the normal group. The number of

nuclei with smooth contours was definitely greater in the stroma of the hyperplastic tissues than in the normal proliferative (Table VII, Chart 9). The averages of solid "pycnotic" nuclei were small in both groups of this tissue.

Normal tissues and specimens of bleeding endometrium. Table IX incorporates the data on 12 tissues secured from patients who were bleeding at the time the specimen was obtained and had been doing so for the periods of time indicated in the first column of the table. This data has been included for comparison with that on normal tissues contained in Table VIII. The day 9 bleeding specimen resembled somewhat the day 8 and day 10 normal tissues in chromatin distribution in both glands and stroma and the day 14 and day 23 bleeding tissues likewise resembled the day 14 and 23 normal tissues.

EVALUATION OF STUDY

The relation of the presence of aggregate granular chromatin to the presence of mitotic figures, especially in those tissues manifesting the characteristics generally attributed to proliferation in the endometrium and the fact that the follicular hormone is known to be responsible for these characteristics, suggests that the aggregate type of granular chromatin

distribution is associated with the presence of the follicular hormone. The more varied nuclear pictures encountered in the tissues secured during the secretory phase of the cycle may well be due to the simultaneous action of the corpus luteum and follicular hormones upon the endometrium since there are fewer tissues with the aggregate type of chromatin in the secretory specimens even though the number of these specimens containing mitotic figures is relatively high (Charts 7 and 8).

Certain points must not be lost sight of in evaluating the results herein described. The number and types of tissue included were such that no sweeping conclusions regarding endometrial modifications have been justified and those conclusions tentatively advanced are based upon results obtained by grouping tissues with similar characteristics and averaging the occurrence of certain nuclear forms for comparison in the various groups. The information concerning mitosis may be misleading if the reader does not keep in mind that the presence of one mitotic figure or of many such entitled a specimen to be listed as manifesting mitotic activity so that the figures on cell division are qualitative and not quantitative reports. The determination of the type of distribution of the chromatin granules contains a subjective element impossible to ignore and the intergrades of distribution between a typical diffuse and a typical aggregate distribution of granules are often difficult to determine.¹

The figures for the charts have been compiled by calculating the percentages of various factors occurring in each of the groups of tissue. For example in Chart 2 column 2 48 of the 52 specimens designated as proliferative in character or 92 per cent of the tissues in that group contained the aggregate type of chromatin in the gland epithelium while 45 of the 52 or 86 per cent of the specimens

had at least 1 mitotic figure in the gland epithelium. In Table I Chart 1, there were 36 specimens containing diffuse chromatin in the stroma and the average of all the cell counts of solid 'pycnotic' nuclei in the stroma of these 36 tissues was 27 per cent. There was an average of 6.6 per cent solid pycnotic nuclei in the stroma of the 99 tissues containing the aggregate chromatin in the stromal cells. Thus it is obvious that this study yields characteristics for groups of similar tissues rather than specific characteristics of individual tissues.

Some elements of this investigation yield quantitative evidence for long established qualitative characteristics of endometrium from a physiological standpoint. This is apparent in regard to the proliferative action of the follicular hormone upon the endometrium as well as to the difference between the gland and stromal cells in responding to hormonal stimuli. The threshold response of stromal tissues to hormonal stimulus is higher than that of the epithelial cells hence the stromal response appears to lag (79-80) behind that of the epithelium as the hormone level changes. The normal proliferative and hyperplastic tissues almost uniformly containing aggregate chromatin and mitotic figures (Charts 7 and 8) histologically demonstrate the relation of the follicle hormone to tissue proliferation. This same group of tissues in which there are more specimens with mitotic figures in the glands than there are with mitotic figures in the stroma may well indicate the lag of the stroma in response to hormonal stimuli (Charts 7 and 8). This stromal lag is probably further demonstrated in the group of secretory tissues (both normal and first degree failure specimen) where there are more tissues containing aggregate chromatin and mitotic figures in the stroma than there are specimens with aggregate chromatin and mitotic figures in the gland epithelium since the gland tissue during the secretory phase of the cycle is more concerned with the hormone of the corpus luteum than that of the follicle (Charts 7 and 8, columns 3 and 4).

This study has directed attention to the form of nuclei and their structure in the endo-

¹ As mentioned elsewhere, the three grades of distribution were used in this study. Records were kept of the type of distribution of the chromatin granules in the tissues. (1) the most typical aggregate type, (2) the transitional type which could not be considered a definite aggregate type, and (3) the diffuse type of distribution. In computing the percentage of specimens having diffuse or aggregate form of chromatin within the various groups of tissues, all specimens approximating the diffuse distribution were included with the typical diffuse specimens and all those approximating the aggregate were included with the typical aggregate specimens. This study employed the tables and charts.

TABLE VIII.—NORMAL SPECIMENS OF ENDOMETRIUM FROM NORMAL CYCLES

Day in cycle	Tissue number	Chromatin glands	Stromal nuclei			Tissue reaction	Length previous cycle	Length present cycle
			Types of granules	% smooth nuclei	% solid nuclei			
Menstrual								
1	4446	Diffuse	Diffuse	16.9	11.5	Menstrual	31	34
	4510	Diffuse	Diffuse	31.3	11.7	Menstrual	29	27
2	4753	Intermediate	Diffuse	10.1	20.7	Menstrual	28	30
	4853	Diffuse	Diffuse	8.7	20.0	Menstrual	30	30
3	4899	Aggregate	Aggregate	47.0	2.8	Menstrual	28	31
Postmenstrual and intercalary								
5	4906	Aggregate	Aggregate	46.5	0.6	Postmenstrual	27	27
8	4659	Diffuse*	Diffuse	21.8	15.7	Interval	26	25
10	4912	Diffuse	Intermediate	21.9	16.8	Postmenstrual	28	33
11	4737	Aggregate*	Aggregate	30.2	2.5	Estro	28	28
13	4653	Aggregate*	Aggregate*	51.2	0.6	Estro	27	27
17	4939	Aggregate*	Aggregate*	60.0	0.6	Estro	28	33
18	4755	Aggregate*	Aggregate*	47.5	0.0	Estro	28	28
Secretory								
14	4681	Diffuse*	Diffuse*	38.1	1.1	Early secretory	30	28
16	4798	Intermediate	Intermediate	4.3	10.0	Early secretory	28	30
18	4603	Diffuse*	Diffuse	49.6	1.1	Secretory	30	26
19	4603	Aggregate	Aggregate*	23.6	5.0	Secretory	27	27
21	4604	Diffuse*	Diffuse*	55.0	0.6	Secretory	30	27
23	4736	Diffuse*	Diffuse*	12.6	35.0	Secretory	30	29
24	4910	Intermediate	Intermediate	4.1	1.8	Secretory	30	30
	4650	Diffuse*	Diffuse*	66.0	0.0	Secretory	30	26
25	4776	Aggregate	Aggregate	45.6	7.1	Secretory	28	28
	4030	Intermediate*	Aggregate*	59.0	2.7	Secretory	28	33
26	4759	Diffuse*	Intermediate*	18.5	3.4	Secretory	27	27
27	4801	Diffuse	Diffuse*	41.2	1.9	Secretory	32	28
31	4964	Diffuse	Intermediate*	62.4	2.1	Secretory	28	11

*Mitotic figures present in tissue

metrium which may prove of value in determining the normal and abnormal endocrine balances in the menstrual cycle. This idea appears feasible with reference to the lag reaction of stroma mentioned, the stroma, because of its higher threshold response, is more sensitive to hormone withdrawal than is the gland epithelium. Because of this difference in tissue response, it is entirely possible that the stroma may prove to be the tissue upon which the diagnoses of the earliest endocrine imbalances may be made. This concept is supported by the evident contrast of mitotic activity in the stroma of the normal secretory specimens and of the first degree failure

secretory specimens (Chart 8). The number of specimens with mitotic figures is greater in the group of normal tissues, although there are few specimens with frank aggregate chromatin, than it is in the first degree failure specimens which predominantly have the aggregate chromatin in the nuclei of the stroma, but in only a few instances contain mitotic figures in this region (Chart 8, columns 3 and 4).

On the other hand, no such contrast exists between the stroma of first and second degree failure specimens of endometrium, for the only difference is in the number of specimens which contain mitotic figures. The contrast between

shown to be due to vascular phenomena dependent upon fluctuations in the follicular hormone content of the blood, then these waves of pycnosis would afford histological evidence of weekly variations in the production of the follicular hormone (Table VIII), such weekly fluctuations in the excretion of the follicular factor, whether in free or combined form, are indicated in the charts in the literature on follicular hormone excretion (42, 46, 85, 86), while a lessening of mitotic activity has been reported in specimens of endometrium secured on days 9 (56), 10 (50) 14 (56), 16 (77) and 23 (56)

SUMMARY

A study of 200 specimens of human endometrium, obtained from normal women and from women exhibiting various degrees of ovarian failure revealed that two forms of nuclei can be distinguished, namely, a granular and a non granular or solid homogeneous form. Further, the granular form of nucleus showed two distinct types of chromatin distribution, aggregate and diffuse. The aggregate type of granule distribution appeared almost uniformly in the nuclei of endometrial specimens diagnosed as presenting the characteristics of proliferation, but was not predominant in the secretory or menstrual tissues.

Hence the conclusion seems justified that the aggregate type of chromatin distribution is characteristic of human endometrium which is under the influence of the follicular hormone alone (normal proliferative phase, second degree ovarian failure). As a whole, tissue from women with first degree ovarian failure showed the aggregate type of chromatin in the stroma more frequently than did tissue obtained from normal women during the secretory and menstrual phases. On the other hand the gland chromatin in tissue associated with first degree ovarian failure showed no significant differences from that of the normal. These observations suggest that differences in the threshold response of the gland and stromal nuclei of the human endometrium to hormonal stimulation may furnish a basis for determining fluctuations in endocrine levels.

The author wishes to acknowledge the courtesy and co-operation of the Department of Obstetrics and Gynecology in permitting free access to their tissue files and records.

REFERENCES

- 1 ALLEN, I. DEAR. The menstrual cycle of the monkey *Macacus rhesus*. Observations on normal animals the effects of removal of the ovaries and the effects of injections of ovarian and placental extracts into spayed animals. Contributions to Embryology Washington Carnegie Institute 1927, 19 1-44
- 2 ALLEN, I. and DOISY, E. A. An ovarian hormone. Preliminary report on its localization, extraction and partial purification and action in test animals. *J Am M Ass* 1923 81 819-821
- 3 ALLEN, I. PRATT, J. P. NEWELL, Q. U. and BLAND, I. J. Human tubal ova related early corpora lutea and uterine tubes. Contributions to Embryology Washington Carnegie Institute 1930, 22 45-76
- 4 ALLEN, W. M. Physiology of the corpus luteum. V. Preparation and some chemical properties of progesterin a hormone of the corpus luteum which produces progestational proliferation. *Am J Physiol* 1930 92 174-188
- 5 ASCHOFF, S. Zur Histologie der Uterusschleimhaut. Ueber das Vorkommen von Fettsubstanzen. *Ztschr f Geburtsh u Gynaek* 1915 77 495-496
- 6 BACHTIN, C. Oestrogenic hormone and mechanism of corpus luteum formation in the rabbit. *Proc Soc Exper Biol & Med* 1936 33 551-554
- 7 BANISTER, H. Der Frage der Funktion im Schleimhautteil des Uterus. *Arch f path Anat u Physiol* 1937 299 376-425
- 8 BARTELMER, C. W. Histological studies on the menstruating mucous membrane of the human uterus. Contributions to Embryology Washington Carnegie Institute 1933 24 143-186
- 9 BARTLEMER, G. W. and HENSLER, C. M. Human uterine gland cells. *Special Cytology* 1932 3 1525-1565
- 10 BENSLEY, C. M. Glycogen in pregravid menstrual and pregnant stages. *Anat Rec* 1928 38 68
- 11 BRENNFCKE, Zur Aetiologie der Endometritis lunosa specielle der chronischen hyperplasien den Endometritis. Olhausen's *Arch f Gynaek* 1882 6 455-486
- 12 BURCH, J. C. The general significance of disorders of menstrual interval and flow. *Internat Clin* 1937 4 65-70
- 13 BURCH, J. C. McFILLAN, C. S. JOHNSON, C. D., and ELLISON, F. T. The diagnosis and classification of menstrual disorders. *J Am M Ass* 1937 108 96-100
- 14 BURCH, J. C., PHILIPS, DORIS and WOLFE, J. M. Endometrial hyperplasia. *Arch Path* 1934 17 799-826
- 15 BURCH, J. C. WILLIAMS, W. J. and CUNNINGHAM, R. S. Etiology of endometrial hyperplasia. *Surg, Gynec & Obst* 1931, 52 338-345
- 16 BURCH, J. C. WOLFE, J. M. and CUNNINGHAM, R. S. Experiments on endometrial hyperplasia. *Endocrinology*, 1932 16 541-546
- 17 BUTENANDT, A. Untersuchungen ueber das weibliche Sexualhormon. Darstellung und Eigenschaften des kristallisierten Progynons. *Deutsche med Wchenschr* 1929 55 2171-2173
- 18 BUXTNER, O. Anatomische und klinische Untersuchungen ueber Endometritis. *Arch f Gynaek* 1910 9 781-808

- 19 CAMPBELL R E LENDRUM F C and SEVERINGHAUS E L Endometrial histology and pathology as revealed by the biopsy method *Surg. Gynec. & Obst.* 1936 63 724-731
- 20 CLAUBERG C Nachweis der Wirkung künstlich zugeführten Lutealhormons am menschlichen Uterus *Zentralbl. f. Gynaek.* 1933 57 1461-1468
- 21 CLAUS P E Separation of anterior lobe substances and study of their individual effects *Physiol. Zool.* 1931 4 36-57
- 22 CORNER GEORGE W Ovulation and menstruation in *Macacus rhesus* Contributions to Embryology Washington Carnegie Institute 1923 15 73-102
- 23 Idem The relation between menstruation and ovulation in the monkey its possible significance for man *J. Am. M. Ass.* 1927 89 1838-1840
- 24 Idem Physiology of the corpus luteum I Effects of very early ablation of the corpus luteum upon embryos and uterus *Am. J. Physiol.* 1928 86 74-87
- 25 CORNER G W and ALLEN W M Physiology of the corpus luteum II Production of a special uterine reaction (progestational proliferation) by extracts of the corpus luteum *Am. J. Physiol.* 1929 88 326-346
- 26 COSTE J J M C V Recherches sur la gestation dans l'espèce humaine *Compt. rend. Acad. d. sc. Par.* 1841 15 59-63 162-167
- 27 Idem Note sur la nature de la caduque chez l'espèce humaine *Compt. rend. Acad. d. sc. Par.* 1847 24 893-894
- 28 CZEPIEN A Ueber die Beziehungen der Uterusschleimhaut zu den Erkrankungen der Adnexe *Ztschr. f. Geburtsh. u. Gynaek.* 1886 13 339-350
- 29 DALTON JOHN C Prize essay on the corpus luteum of menstruation and pregnancy *Tr. Am. M. Ass.* 1851 4 540-644
- 30 DAY J I PHELPS D ELLISON E T and BURCH J C The effects of various gonadotropic substances upon ovaries, pituitaries and adrenals of animals receiving long term injections of estrin *Am. J. Physiol.* 1938 121 794-799
- 31 DOISY E A VILER C D and THAYER S Preparation of crystalline ovarian hormone from urine of pregnant women *J. Biol. Chem.* 1930 86 499-509
- 32 DUDGEON L S and BARRETT N R Examination of fresh tissues by the wet film method *Brit. J. Surg.* 1934 32 4-22
- 33 ELLISON E T and BURCH J C Effect of estrogenic substances upon the pituitary, adrenals and ovaries *Endocrinology* 1936 20 746-752
- 34 ENGELMANN G J The mucous membrane of the uterus with special reference to the development and structure of the decidua *Am. J. Obst.* 1875 8 30-87
- 35 FEVOLD H L HISAW F L and GREEP R Effect of oestrin on activity of anterior lobe of pituitary *Am. J. Physiol.* 1936 114 508-513
- 36 FEVOLD H L HISAW F L and LEONARD S L Gonad stimulating and luteinizing hormones of anterior lobe of hypophysis *Am. J. Physiol.* 1931 97 291-301
- 37 FINDER H K Comparative cytological study of benign and malignant tissues *Am. J. Cancer* 1915 25 772-779
- 38 FINKLER R S and FRIEDMAN M Diversified clinical and pathological pictures of failing ovarian function *Endocrinology* 1938 22 104-110
- 39 FLUHMANN C F Hyperplasia of the endometrium and the hormones of the anterior hypophysis and ovaries *Surg. Gynec. & Obst.* 1931 52 1057
- 40 FRAENKEL L Die Function des Corpus luteum *Arch. f. Gynaek.* 1903 68 438-545
- 41 Idem Neue Experimente zur Function des Corpus luteum *Arch. f. Gynaek.* 1910 91 705-761
- 42 FRANK R T GOLDBERGER M M and SPIELMAN F Present endocrine diagnosis and therapy A critical analysis based on hormone studies in the female *J. Am. M. Ass.* 1934 103 393-402
- 43 FRANZ K Ein Beitrag zur Kenntniss der Endometritis hyperplastica ovarialis *Arch. f. Gynaek.* 1898 56 363-371
- 44 GEIST S H Untersuchungen ueber die Histologie der Uterusschleimhaut *Arch. f. mikr. Anat.* 1913 81 196-219
- 45 GOHLISCH I Mensueller Zyklus und Lipidgehalt der Uterusschleimhaut *Monatsschr. f. Geburtsh. u. Gynaek.* 1933 pp 223 227
- 46 CUSTAVSON R G and GREEN D F Quantitative determination of the amount of estrogenic substances excreted daily in the urine of the normal human female *J. Biol. Chem.* 1934 34 105 36
- 47 HARTMAN C G Studies in the reproduction of the monkey *Macacus (Pithecus) rhesus* with special reference to menstruation and pregnancy Contributions to Embryology Washington Carnegie Institute 1932 23 1-161
- 48 HALSSMANN D Lehre von Decidua Menstrualis *Beitr. z. Geburtsh. u. Gynaek.* 1872 1 755-778
- 49 HENPE W The menstruation of *Semnopithecus entellus* *Phil. Tr. Lond.* 1894 183B 417-471
- 50 HITSCHMANN F and ADLER L Der Bau der Uterusschleimhaut des geschlechtsreifen Weibes mit besonderer Berücksichtigung der Menstruation *Monatsschr. f. Geburtsh. u. Gynaek.* 1908 27 1-82
- 51 HOMBERG W Veränderungen des Hypophysen vorderlappens und des Ovariums nach Behandlung mit grossen Dosen von Follikelhormon *Klin. Wchnschr.* 1934 13 92-95
- 52 HORMANN K Ueber das Bindegewebe der weiblichen Geschlechtsorgane III Die Bindegewebsfasern in der Schleimhaut des Uterus *Arch. f. Gynaek.* 1908 86 404-433
- 53 HORNING E S and RICHARDSON K C Cytological differences between normal and malignant tissues *Med. J. Australia* 1930 1 238-247
- 54 KAUFMANN C Die Behandlung der Amenorrhoe mit hohen Dosen der Ovarialhormone *Klin. Wchnschr.* 1933 12 1557-1562
- 55 Idem Therapeutics with hormones of the ovary *Proc. Roy. Soc. Med.* 1934 27 849-861
- 56 KELLER R and SCHICKLE G Die menstruellen Veränderungen der Uterusschleimhaut *Monatsschr. f. Geburtsh. u. Gynaek.* 1911 34 621-645
- 57 KNACER E Die Ovarientransplantation Experimentelle Studie *Arch. f. Gynaek.* 1900 60 322
- 58 KUNDRAT and ENGELMANN G J Untersuchungen ueber die Uterusschleimhaut *Strickers med. Jahrbuch* 1873 p 135
- 59 LANE C E Some influences of estrin on the hypophyseal gonad complex of the immature female rat *Am. J. Physiol.* 1935 120 681-685
- 60 LEIBY G L Effect of theelin on weights of pituitaries ovaries and adrenals *Proc. Soc. Exper. Biol. & Med.* 1933 31 16-17
- 61 LEOPOLD G Untersuchungen ueber Menstruation und Ovulation *Arch. f. Gynaek.* 1883 21 347

- 62 LOEB, L. The production of deciduomata and the relation between the ovaries and the formation of the decidua. *J Am M Ass* 1903 50 1897-1901
- 63 Idem. Ueber die Bedeutung des Corpus luteum fuer die Periodizitaet des sexuellen Zyklus beim weiblichen Säugetierorganismus. *Deutsche med Wchnschr* 1911 37 17-21
- 64 MACCARTY W C. Cancer cell and nature's defensive mechanism. *Surg Gynec & Obst*, 1925 41 783-793
- 65 MCCLELLAN G S, PHILIPS DORIS and BURCH J C. Endometrial studies. *Endocrinology* 1935 29 321
- 66 MARKEE J F. Rhythmic vascular uterine changes. *Am J Physiol* 1932 100 32-39
- 66a Idem. Menstruation in ocular endometrial transplants. *Anat Rec (suppl)* 1932-1933 55 66
- 67 MEYER R. Beitrage zur Lehre von der normalen und krankhafte Ovulation und der mit ihr in Beziehung gebrachten Vorgaenge am Uterus. *Arch f Gynaek* 1920 113 259-315
- 68 MEYER R, LEONARD S L, HISSAN F L and MARTIN, S J. Effect of oestrin on gonad stimulating power of the hypophysis. *Proc Soc Exper Biol & Med* 1930 27 702-704
- 69 MOORE C R and PRICE D. Gonad hormone functions and the reciprocal influence between gonads and hypophysis with its bearing on problem of sex hormone antagonism. *Am J Anat* 1932 50 13
- 70 NORRIS C C and KEENE F E. Changes in the normal endometrium during menstrual life based upon the study of 100 cases. *Surg Gynec & Obst* 1910 10 44-54
- 71 NOVAK E. Pathologic physiology of uterine bleeding. *J Am M Ass* 1914 63 617-621
- 72 Idem. Hyperplasia of the endometrium. *Am J Obst & Gynec* 1917 75 996-1001
- 73 Idem. The bearing of recent work on the anterior pituitary hormones upon gynecological problems with especial reference to disorders of menstruation. *Endocrinology* 1931 15 273-280
- 74 O'LEARY J L. Form changes in the human uterine gland during the menstrual cycle and in early pregnancy. *Am J Anat* 1929 43 289-346
- 74a Idem. A quantitative study of the relation of nucleus to cytoplasm in the human endometrium during the menstrual cycle. *Anat Rec*, 1931 50 33-44
- 74b O'LEARY J L, and CULBERTSON C. Form changes in the human uterine gland during the menstrual cycle. *Surg Gynec & Obst* 1928 46 227-239
- 75 PARKES, A S. Experimental endometrial hyperplasia. *Lancet* 1935 1 485-486
- 76 SCHICKLE G and KELLER R. Ueber die sogenannte chronische Metritis und die kleinsten Degeneration der Ovarien ihre Beziehungen zu den Uterusblutungen. *Arch f Gynaek*, 1917 95 609-633
- 77 SCHROEDER R. Die Drüsenepithelveränderungen der Uterusschleimhaut im Intervall und Pre-menstruum. *Arch f Gynaek* 1909 88 1-28
- 78 Idem. Beitrage zur normalen und pathologischen Anatomie des Endometriums. *Arch f Gynaek* 1912 98 81-135
- 79 Idem. Anatomische Studien zur normalen und pathologischen Physiologie der Menstruationszyklus. *Arch f Gynaek* 1915 104 27-102
- 80 Idem. Die Pathologie der Menstruation. *Halban Sitz Biol u Path des Weibes* 1924 3 921-1024
- 81 SELYE H, COLLIP J B and THOMSON D L. Effect of oestrin on ovaries and adrenals. *Proc Soc Exper Biol & Med* 1935 32 1377-1381
- 82 SHAW, W. Relation of ovarian function to menstruation. *J Physiol*, 1925 60 193-207
- 83 SIMPSON J W, and BURCH, J C. Experimental production of glandular cystic hyperplasia with estrogenic substances of parturient urine. *Proc Soc Exper Biol & Med*, 1935 32 1570-1571
- 84 SIMPSON J W, ILLISON I T, PHILIPS DORIS and BURCH J C. Evaluation of the hypophyseal factor in the interpretation of endometrial changes. *Am J Obst & Gynec* 1936 32 120-134
- 85 SMITH G V S and SMITH O W. Quantitative determination of urinary oestrin. *Am J Physiol* 1935 112 340-350
- 86 SMITH G V S and SMITH O W. The urinary excretion of estrogenic and gonadotropic hormones during menstrual cycles: the period of conception and early pregnancy. *New England J Med* 1936 215 908-914
- 87 SMITH P F. Hastening development of female genital system by daily homoplastic pituitary transplants. *Proc Soc Exper Biol & Med*, 1926, 24 131-132
- 88 SMITH I L and FOLGER F T. Experimental evidence regarding the rôle of the anterior pituitary in the development and regulation of the genital system. *Am J Anat* 1927 40 159-217
- 89 STURGIS S H and MEIGS J V. Endometrial cycle and mechanism of normal menstruation. *Am J Surg* 1936 33 369-384
- 90 TEACHTER J H. Normal structure of endometrium and decidua and the menstrual cycle. *Brit M J* 1930 2 896-897
- 91 TERRUEN L. Ueber die morphologische Zellstruktur des Endometriums. *Ztschr f Geburtsh u Gynaek*, 1925-1926 89 497-505
- 92 TIETZE K. Die Follikelpersistenz mit glandulaerer Hyperplasie des Endometriums in vergleichender pathologischer experimenteller und genetischer Beziehung. *Ztschr f Geburtsh u Gynaek*, 1934 108 70-120
- 93 TRAUT H I and KELLER A. Irregular shedding and irregular opening of endometrium. *Surg, Gynec & Obst* 1935 61 145-155
- 94 TURCHINI, J and BROUSSY J. Sur la structure cytologique et plus spécialement l'appareil de golgi de l'épithélium utérin et de ses cryptes. *Arch d anat micr*, 1929 25 597-600
- 95 WALLEN LAWRENCE Z. Proof of the existence of a follicle stimulating and a luteinizing hormone in the anterior lobe of the pituitary body. *J Pharm & Exper Therap*, 1934 51 263-286
- 96 WARSON M C. Endocrine factors in normal and abnormal menstruation. *Canadian M Ass J*, 1937, 37 337-340
- 97 WEGELIN C. Der Glykogengehalt der Schleimhaut Uterusschleimhaut. *Centralbl f allg Path u path Anat* 1917, 22 1-8
- 98 WEXNER, A A and COLLIER W D. The effect of theelin injections on the castrated woman. *J Am M Ass*, 1933 100 633-640
- 99 WESTPHALEN F. Zur Physiologie der Menstruation. *Arch f Gynaek*, 1896, 52 35-70
- 100 WOLFE J M. Reaction of ovaries of mature female rats to injections of oestrin. *Proc Soc Exper Biol & Med* 1935 32 757-759
- 101 Idem. Reaction of anterior pituitaries of mature female rats to injections of large amounts of oestrin. *Proc Soc Exper Biol & Med*, 1935 32 1192-1195

- 102 WOLFE J M CAMPBELL MARY and BURCH J C
Production of experimental endometrial hyper-
plasia Proc Soc Exper Biol & Med 1932 29
1263-1265
- 103 YOUNG J Structure of the stroma of the endome-
trium and its bearing on the menstrual changes
Brit M J 1910 2 1214-1217
- 104 ZONDER B Ueber die Hormone des Hypophysen-
vorderlappens I Wachstumshormon Follikel-
reifungshormon (Prolan A) Luteinisierungshormon
(Irolan B) Stoffwechsellhormon? Klin Wchenschr
1930 9 245 249
- 105 Idem Die Hormone des Ovariums und des Hypo-
physenvorderlappens Berlin Springer 1931
- 106 ZONDER B and ASCHHEIM S Das Hormon des
Hypophysenvorderlappens I Testobjekt zum
Nachweis des Hormon Klin Wchenschr 1927 6
248-252
- 107 Idem Hypophysenvorderlappen und Ovarium.
Beziehungen der endokrinen Druesen zur Ovarial-
funktion Arch f Gynaek 1927 130 1-48
- 108 ZUCKERMAN S and MORSE A H Experimental
production of excessive endometrial hyperplasia
Surg Gynec & Obst 1935 61 15-19

PAPILLARY TUMORS OF THYROID AND LATERAL ABERRANT THYROID ORIGIN

GEORGE CRILE, Jr, M D, Cleveland, Ohio

ALTHOUGH any study of tumors of the thyroid is rendered difficult by the multitude of different classifications that have appeared in the literature, the papillary tumors form a fairly distinct group. This group includes the papillary adenoma and the papillary carcinoma. Papillary tumors, either benign or malignant, may originate in the thyroid gland proper, in lateral aberrant thyroid tissue, or they may co exist in both the thyroid and the lateral cervical regions. The papillary carcinomas constitute 17.7 per cent of all carcinomas of the thyroid in the Cleveland Clinic series.

PAPILLARY TUMORS OF THE THYROID GLAND

In the present discussion of papillary tumors only those tumors 2 centimeters or more in diameter are considered. Therefore, when we refer to a papillary adenoma or carcinoma of the thyroid, this can be taken to mean a gross tumor of clinical importance.

As Graham (14, 15) has repeatedly stated, the various groups of neoplastic lesions of the thyroid blend almost indiscernibly into one another. In a series of malignant tumors of the thyroid gland he says, "We find all grades of transition of the original adenoma into all types and combinations of morphological cancer mentioned in the literature, except pure papilliferous adenocarcinoma and pure scirrhous carcinoma. These various combinations of adenoma and morphological cancer are present in the series of tumors and frequently in a single tumor."

The difficulty encountered in classifying carcinomas of the thyroid is often increased by the finding of one type of cellular arrangement in one part of the tumor and quite a different arrangement in another part of the same tumor. Thus a malignant adenoma, in which the tumor is invading the blood vessels,

may in one section show a medullary arrangement and in another a well differentiated papillary structure. Therefore, in the group under consideration we have eliminated all cases of papillary carcinoma in which there were present medullary areas with invasion of blood vessels by the tumor. A tumor which shows invasion of the blood vessels is here classified as a malignant adenoma even though it contains papillary areas.¹

The tumors included in this study are divided into 3 groups. First, the papillary adenomas which are considered to be benign from a histological standpoint (15 cases), second, those which either as a result of invasion of the capsule or the appearance of the cells were considered to be malignant (20 cases), and lastly, the tumors arising in lateral aberrant thyroid tissue (13 cases).

Although it is not so difficult to set off the group of pure papillary tumors from other adenomas and carcinomas of the thyroid, it is extremely difficult from a histological standpoint to differentiate between the benign and malignant papillary tumors. No two pathologists would agree as to which tumors in this group were benign and which malignant. This is not surprising when the subsequent course is reviewed and it is found that in certain cases in which the tumor was apparently incompletely removed and in which the histological appearance of the tumor suggested carcinoma, the patients are alive without evidence of recurrence 5 years or more after operation. It is equally significant to note that in no instance have we observed either distant or regional metastases from papillary tumors which did not show tumor cells within blood vessels.

Only 5 of the 35 patients with papillary tumors of the thyroid have died as a result of

¹Invasion of blood vessels is rarely seen in tumors that are predominantly papillary. It was necessary to reclassify only 3 papillary carcinomas because of the finding of blood vessel invasion by tumor tissue.

the tumor. In 1 case a biopsy was performed and death occurred a year later. No information as to the exact cause of death can be obtained. In the second case a fatal hemorrhage occurred a month after the tumor was treated with radium probably a result of slough secondary to the irradiation. In the third, fourth, and fifth cases local recurrences of incompletely removed tumors were responsible for the patients' deaths 7 months, 16 months and 3 years, respectively, after the operations had been performed.

In 5 instances the patients are alive and well from 2 to 11 years after what appeared to be an *incomplete* removal of tumors classified as papillary carcinomas. Radiation therapy was given in 4 of these 5 cases but in 1 case the patient has remained alive and well 11 years without radiation therapy. In this case, examination of the gross specimen showed that the tumor appeared to have been incompletely removed.

In addition to these 35 cases of papillary tumors of the thyroid itself we have observed 13 cases of papillary tumors arising in lateral aberrant thyroid tissue. In 5 of these 13 cases the thyroid gland has contained papillary tumors similar to the tumors in the lateral cervical region. In 3 cases the thyroid tumor was believed to be malignant yet no patient has died as the result of the disease. In no instance has distant metastasis occurred and in no instance have we any proof that the lateral nodules are metastases rather than multiple primary tumors.

In short it would appear that the papillary group of tumors of thyroid and lateral aberrant thyroid origin are remarkably benign do not tend to metastasize and if completely removed will not recur. Even an apparently incomplete removal has been followed in 1 instance by no recurrence over a 4 year period. It is, therefore, questionable whether these tumors are true carcinomas or whether they should be classified as only locally malignant as are the mixed tumors of the salivary glands.²

TUMORS OF LATERAL ABERRANT THYROID ORIGIN

Literature. In 1932, Moritz and Bayless reported 6 tumors of lateral aberrant thyroid origin and collected 103 cases from the literature. Since that time 26 additional cases have been reported making a total of 135 cases. Moritz and Bayless classified 31 of their collected cases as malignant and since their report this number has been increased to 45.

Only 2 of the 45 patients with malignant tumors of lateral aberrant thyroid origin have been reported to have died as a result of recurrence of the tumor following operation. In no case has either local or distant metastasis of the tumors been proved. The remarkable survival record of these patients cannot fail to raise the question of whether or not the tumors in question are really malignant.

The strongest advocate of the malignancy of lateral aberrant thyroid tumors has been Dunhill who reported 4 cases, 2 of which he was unable to trace more than 3 years after operation. In the third case a local recurrence developed and the patient died without evidence of distant metastasis 9 months after operation. The fourth patient died as a result of intestinal obstruction secondary to a pelvic malignancy, the type of malignancy having apparently never been determined. The only deduction that can be drawn from this group of cases is that tumors of lateral aberrant thyroid origin may recur locally if they are not completely removed.

Many of the tumors in the collected series were described as showing extensive metastasis to the cervical lymph nodes. Similarly it has repeatedly been stated in the literature (8, 31) that metastasis to the regional lymph nodes is commonly associated with papillary carcinoma of the thyroid.

In our experience papillary tumors of the thyroid have not metastasized to lymph nodes. Recently it has been recognized (6) that in the presence of lateral aberrant thyroid tumors, the thyroid gland is apt to contain coincidentally 1 or more papillary tumors similar to those in the lateral cervical regions. It is, therefore, clear that it is difficult to differentiate between (1) a papillary adenoma of the thyroid associated with

²Of the 3 cases formerly classified as papillary carcinoma but eliminated from this series because of distant metastasis, 1 patient is alive and without recurrence 10 years after operation and the third died 5 1/2 years after operation.

multiple papillary adenomas of lateral aberrant thyroid origin, and (2) a papillary carcinoma with metastasis to the cervical nodes. Histologically there is little to differentiate the two.

Lymphoid tissue tends to be present in all lateral cervical sinuses, cysts, and other embryological anomalies of the neck. Lateral aberrant thyroid tumors are no exception to this rule as they also tend to contain considerable lymphoid tissue and may have the histological appearance of a lymph node containing metastatic carcinoma (Fig 1). In short the final answer to the question as to whether these tumors are benign primary tumors or metastatic carcinoma must be decided by the clinical course of the tumor and the survival of the patient. Since there is no case either in our series or in the literature in which the tumor has continued to disseminate itself after operation and has thereby caused the death of the patient, it would appear that these tumors are essentially benign and should not be classified as metastasizing carcinomas of the thyroid.

Clinical material. In the past 15 years, 13 patients with tumors arising in lateral aberrant thyroid tissue have been seen at the Cleveland Clinic. By some freak of distribution I have operated upon 6 of these in the last 2 years. Four cases in this group are of particular interest from both clinical and pathological standpoints, not only because of the extensiveness of the involvement, but also because of the difficulties involved in interpreting the histology of the tumors.

CASE 1. The patient was a married woman 27 years of age who complained of a painless lump in the posterior triangle of the neck just above the clavicle. The enlargement was noted during a pregnancy. Examination showed a slight, firm enlargement of the left lobe of the thyroid, multiple soft movable tumors in the posterior triangle on the left, and several small soft nodules deep to the sternomastoid on the right. A clinical diagnosis of tuberculous glands, possibly lateral aberrant thyroid, was made and one of the nodules was removed for microscopic examination.

The nodules were found to be papillary adenomas arising in lateral aberrant thyroid tissue and their removal was advised. At the time of operation, 25 separate nodules were dissected out of the neck and the left lobe of the thyroid was completely removed.



Fig 1. Photomicrograph of lateral aberrant thyroid nodule showing large amount of lymphoid tissue closely associated with the epithelial elements (Case 2).

This lobe showed a diffuse papillomatosis extending medially nearly to the isthmus. The lateral nodules were encapsulated but some of them were quite adherent. Those close to the trachea and the left lobe of the thyroid were particularly adherent and appeared to be involved in a diffuse inflammatory process which plastered them to the trachea and to one another in firm masses. This reaction was the result of degeneration and calcification of the tumors. The patient is well 1 year after operation (Figs 2, 3 and 4).

CASE 2. The next case is strikingly similar to the one just reported. The patient was also a woman 27 years of age who complained of a painless lump in the neck. Examination showed multiple soft, movable nodules behind the sternomastoid on the right and a hard tumor in the right lobe of the thyroid. A diagnosis of papillary adenoma of the thyroid and multiple papillary adenomas in lateral aberrant thyroid tissues was made. A block dissection of the neck was performed leaving the sternomastoid muscle but taking the jugular vein and the entire right lobe of the thyroid. There were 17 tumor nodules in all, distributed almost exactly as in Case 1. All were papillary adenomas and there was also a papillary adenoma in the right lobe of the thyroid. It is now more than 1 year since the operation and the patient is well and has no evidence of recurrence.

In the last 2 cases the tumors were clearly benign from both the clinical and histological points of view. In the following cases malignancy is more difficult to exclude.

CASE 3. The patient was a woman 45 years of age who was first seen in the Clinic in 1929, complaining of a gradually enlarging mass in the neck. Examination showed a firm, nodular goiter. At the time of

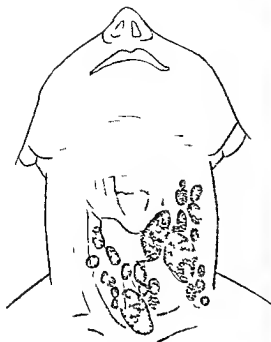


Fig. 2. Drawing to show distribution of lateral aberrant thyroid nodules (Case 1)

operation it was found that the left lobe of the thyroid contained a hard tumor and a number of small nodules were palpable beneath the sternomastoid muscle. A subtotal thyroidectomy was performed by Dr. A. T. Bunts and 4 nodules were excised. A diagnosis of papillary adenoma of the thyroid (? malignant) was made and the nodules were interpreted as papillary adenomas arising in lateral aberrant thyroid tissue. The patient was given 2,800 roentgen units to the neck and has remained well for 9 years with no evidence of recurrence. If these tumors had been the result of metastasis from a papillary carcinoma of the thyroid I am certain that simple excision of the metastatic nodules followed by 2,800 roentgen units would not have cured the disease.

CASE 4. The patient was a man 40 years of age who had noticed a gradually enlarging painless lump in his neck for 1 year prior to entry. Examination showed several firm movable nodules lying behind the sternomastoid muscle and a hard tumor in the right lobe of the thyroid. A diagnosis of papillary adenoma of the thyroid and lateral aberrant thyroid tumors was made. Six nodules were removed and a radical resection of the entire right lobe of the thyroid was performed. The pathologist's diagnosis was malignant adenoma of the thyroid and multiple malignant adenoma arising in lateral aberrant thyroid tissue. There was definite invasion



Fig. 3. Photograph of lateral aberrant thyroid nodules (Case 1)

of the capsule of the thyroid tumor and tumor cells were growing in blood vessel (Fig. 5).

Several months later the patient returned with a recurrent nodule which was palpable in the right side of the neck beneath the sternomastoid. At operation the sternomastoid muscle, the jugular vein and all the tumor bearing tissues of the right side of the neck were removed. Nine more nodules (making 15 in all) were present in this tissue, one being removed from behind the carotid artery and vagus nerve and several from the superior mediastinum. The patient is well 18 months after the first operation and there is no evidence of recurrence or distant metastasis.

The malignant qualities of the tumor as shown by its invasion of the capsule and the blood vessels raises the question of whether the nodules in the neck were metastases from the malignant adenoma in the thyroid. We know however that malignant adenomas of the thyroid rarely metastasize by the lymphatics but tend rather to spread through the blood stream to the lungs. It is quite possible that distant metastasis may occur or that the nodules already removed were actual metastases from the thyroid tumor, but their dis-



Fig. 4 Illustration of section of left lobe of the thyroid showing diffuse papillary adenomatosis of the major portion of the entire lobe (Case 1)



Fig. 5 Photomicrograph of malignant adenoma of the thyroid showing definite invasive qualities. The lateral cervical tumors showed a similar structure (Case 4)

tribution was so similar to that of the nodules in the other cases, and metastasis to the regional lymph nodes is so rarely seen in malignant adenomas of the thyroid, that I believe each tumor is a primary malignant adenoma arising in lateral aberrant thyroid tissue.

Age The ages of the 13 patients in this series varied from 18 to 56, the average age being 34 years. Forty-six per cent of the patients were between 20 and 30 years of age.

Sex Tumors arising in lateral aberrant thyroid tissue are much more common in women than in men, the ratio being 12 to 1 in this series. In 1 case the tumor was first noticed during a pregnancy.

Race Six of the 13 patients in this series and 4 of the 6 patients with extensive multiple tumors were of Jewish extraction.

Symptoms A painless lump which either enlarged very slowly or not at all was the most common symptom. In 23 per cent of the cases, however, the patient had not noticed the tumor and it was discovered only during examination or operation for a goiter. In only 15 per cent of the cases was the mass either painful or tender. The duration of the symptoms varied from 1 week to 5 years and averaged 15 months.

Examination The consistency of the lumps was usually described as being either soft or firm and the nodules were generally considered to be lymph nodes. The extensiveness of the distribution of the nodules was rarely appar-

ent from external examination, their soft consistency and their location deep beneath the sternomastoid rendering them very difficult to palpate. In the cases with multiple tumors in which the thyroid was similarly involved the affected lobe was hard and suggested the presence of either a thyroiditis or a malignancy.

Distribution of nodules The lateral aberrant thyroid tissue was found in all triangles of the neck. In 6 cases the nodules were on the left, in 4 cases on the right and in the remaining 3 cases they were bilateral. In 1 of the bilateral cases, however, there were multiple nodules on one side and only a single nodule on the other. In Cases 11 and 13 there was extensive bilateral distribution of the tumors. It should be noted that in all cases having more than 6 lateral aberrant thyroid nodules, 1 lobe of the thyroid was involved in a similar pathological process. In 4 of these 6 cases the tumors were present in the superior mediastinum. The nodules were also found posterior to the trachea and posterior to the carotid sheath.

Number of nodules The number of nodules varied from 1 to 25, averaging 7. In 4 cases only 1 nodule was found and in 6 cases there were 6 or more separate tumors. In the case in which 25 nodules were present the actual count could be increased to 30 or more by separating tumors which were adherent to one another but were removed in a single mass.

Thyroid gland Two of the 13 patients had colloid adenomatous goiters without hyperthyroidism and 1 gave a history of having had treatment for an adolescent goiter. In 6 cases (all in patients with 6 or more lateral aberrant nodules) it was found that the same process was going on in the lobe of the thyroid on the affected side as in the lateral aberrant tissue.

The findings were as follows: adenopapillomatosis, 2 cases; benign papillary adenoma, 1 case; papillary adenoma (malignant?), 1 case; malignant adenoma (no papillary structure), 1 case; and nodule palpable in thyroid (patient refused operation), 1 case. In only 5 cases was the thyroid normal.

Histology of lateral aberrant thyroid tissue In 5 cases the lateral aberrant thyroid tissue was found to be composed of cystic papillary adenomas. Solid papillary adenomas were present in 5 cases. In 1 case the tumors were papillary adenomas (malignant?) in 1 case the tumors were interpreted as frankly malignant papillary adenomas, and in 1 case they were malignant adenomas with no papillary structure. In this case each of the 17 tumors was apparently an independent malignant adenoma with structure similar to the malignant adenoma in the lobe of the thyroid. An iodine determination done on the lateral aberrant thyroid tissue in case 13 showed 3.4 micrograms of iodine per 100 milligrams of tissue.

Previous treatment In 4 cases roentgen therapy was given before operation without any change in the size of the nodules. In 1 of these cases a biopsy taken at another hospital was reported to have shown metastatic carcinoma. The roentgen therapy failed to produce any degenerative changes in the tumor, did not diminish the size of the nodules and did not prevent the appearance of additional nodules which were later excised.

Diagnosis In only 3 of the 13 cases was the correct diagnosis made before operation. In a fourth case the presence of lateral aberrant thyroid tumors was considered, but the diagnosis of tuberculous glands of the neck was preferred. In all the cases in which the correct diagnosis was made, there were 6 or more nodules in the neck and the lobe of the thyroid on the affected side was involved.

The distribution and consistency of the nodules usually suggest that they are lymph nodes. The pre-operative diagnoses in the 13 cases were: tuberculous glands, 4; lateral aberrant thyroid, 3; branchial cleft cyst, 2; nodules unsuspected until operation (thyroidectomy), 2; lymphoma, 1; abscess, 1.

At the time of operation the nodules were usually recognized as lateral aberrant thyroid tissue. When cystic, there is a characteristic bluish discoloration similar to that of a cystic adenoma of the thyroid. When solid they are of a reddish color and resemble thyroid tissue.

The characteristic feature that differentiates these tumors from lymph nodes is their vascularity and the presence of clearly visible blood vessels in the capsule. In some cases the tumors are adherent to one another and to surrounding structures and may be either calcified or surrounded with thick hyaline or fibrous capsules. These changes occur only when there is degeneration within the tumor and tend to be most marked in the nodules near the trachea.

In this series of 13 cases the tumors of lateral aberrant thyroid origin can be roughly divided into 2 groups. There is first, the group of 4 cases in which palpation and exploration reveal a normal thyroid and only 1 lateral tumor, and second, the group in which more than 6 tumors are present and 1 lobe of the thyroid is similarly involved. In the multiple group, when the thyroid is involved, nothing short of a radical resection of the affected lobe of the thyroid and a thorough exploration of the neck with removal of all nodules has effected a permanent cure. Four of the 6 patients in this group have each been subjected to from 2 to 4 operations because the extent of the involvement was not at first appreciated and complete excision of all tumors was not carried out.

End results Two of the 13 cases in this series have not been traced since operation. None of the 11 remaining patients, all of whom have been followed for periods varying from 4 months to 13 years (an average of over 4 years) has died as a result of thyroid or lateral aberrant thyroid disease, and at the present time no patient is known to be suffer

ing any disability as a result of recurrence. Only 2 patients received deep roentgen therapy after operation.

One of the patients in this series had 2 nodules palpable prior to operation. Only 1 of these (a papillary adenoma) was removed, yet the patient has lived 13 years since operation and the remaining nodule has not enlarged or produced any symptoms. In Case 13 interpreted as a malignant papillary adenoma arising in the lateral aberrant thyroid, the patient is well and has no evidence of recurrence 4 years after operation in spite of the fact that the growth was invasive and was not completely removed. This patient was given 3,400 roentgen units to the affected side of the neck. A third patient had her first 2 operations elsewhere and has had 2 subsequent operations for benign cystic papillary adenomas. At least 6 nodules in all have been removed and now 5 years after the original operation, a nodule is palpable in the right lobe of the thyroid. This was one of our earlier cases and the thyroid itself was not explored at the time of operation. The nodule now palpable is in all probability a papillary adenoma of the thyroid.

In 2 of the remaining cases, recurrences have been excised. The recurrences appeared 2 months after the original operation in 1 case and 8 months after the original operation in the other. In both instances the recurrent nodules were widely distributed and doubtless represented tumors which were so small at the time of the first operation that they escaped detection. To date, therefore, in a series of 13 cases, 4 patients have had proved recurrences all of which have been controlled by a second operation.

Roentgen therapy. Four of the 13 patients in this series received roentgen therapy before operation. In none of these cases was there any appreciable diminution in the size of the nodules nor did the roentgen therapy effect any histological changes or bring about any evidences of degeneration. In 1 case the growth of the tumor continued after 4,000 roentgen units and there was a recurrence of the nodules 8 months after the first operation.

In 2 instances roentgen therapy was given after operation. In 1 of these cases it would

appear that the x ray had held the tumor in check. But similar experiences with other cases in which roentgen therapy was not given cannot fail to suggest that the result might have been the same had no roentgen therapy been used.

Tumors arising in lateral aberrant thyroid tissue grow slowly, are well differentiated, and often seem capable of lying dormant for many years. From their highly differentiated histological appearance it is difficult to see how they could respond to roentgen therapy. Their clinical behavior makes it difficult to evaluate the results of irradiation. Since permanent cure has been effected in all patients subjected to surgery alone I can see no indication for adding roentgen therapy to surgery in the treatment of lateral aberrant thyroid tumors that have been cleanly excised.

Additional cases. There are 2 additional cases that are difficult to classify: the operating notes and pathological reports containing certain inconsistencies which make it impossible to be certain that the tumor was removed from the lateral cervical region. In 1 case, "lobulated, highly differentiated, colloid thyroid tissue" was reported in the wall of a cyst. Clinically, this cyst was described as being in the midline, but at the time of operation an apparent attachment of the cyst to the lateral pharyngeal wall was said to be present. In the second case, in the course of a thyroidectomy a "well differentiated colloid adenoma" was said by the pathologist to have been removed from the lateral cervical region. No mention of this piece of tissue was made in the operating note.

It is interesting to note that neither of these specimens shows any histological evidence of papillary structure or of malignant change. These are the only 2 specimens in this group of lateral aberrant thyroid tumors which fail to show either of these qualities.

Montz and Bayless have reported 2 cases in which tumors, apparently removed from the lateral cervical region and not connected with the thyroid, were found to contain colloid adenomatous thyroid tissue without papillary structure.

In all of Cattell's 13 cases, however, and in the majority of other recently reported tu-

tumors of lateral aberrant thyroid origin the papillary structure is a constant finding. Tumors arising from the median anlage and thyroglossal tract however do not have this tendency to papillary structure. I am inclined therefore to believe that the first of these cases is a thyroglossal tumor and the second merely an adenoma shelled out of the thyroid gland.

CONCLUSIONS

Papillary tumors arising in thyroid and in lateral aberrant thyroid tissue are remarkably benign. The clinical behavior of these tumors whether they are located in the thyroid proper or in the lateral cervical region is so similar that a common embryological origin must be suspected.

If these papillary tumors are completely removed they do not tend to metastasize or to recur locally. If a local recurrence should follow an incomplete operation re-operation rather than palliation with roentgen therapy is advisable. When a papillary tumor is present in the thyroid and multiple nodules of the same histological structure are present in the lateral cervical region these nodules should not be interpreted as incurable metastases from a carcinoma but should be considered as multiple benign tumors and should be removed. Likewise when lateral aberrant thyroid tumors are found the thyroid should be explored to rule out the presence of a similar type of tumor. It is my belief that many cases reported in the literature as papillary carcinomas of the thyroid with metastasis to the regional lymph glands are in reality benign tumors of lateral aberrant thyroid origin with a co-existent tumor in the thyroid gland itself.

Roentgen therapy has not been proved to be of value in the treatment of papillary tumors of thyroid and lateral aberrant thyroid origin. Reliance must therefore be placed upon the complete removal of these tumors by surgery. What may at first seem to be a hopelessly extensive carcinoma with multiple metastasis is often permanently cured by a persistent surgical attack. Despite the extensiveness of many of these operations no deaths have occurred in the hospital following operation.

SUMMARY

1 Twenty cases of papillary carcinomas of the thyroid, 15 cases of papillary adenomas of the thyroid, and 13 cases of papillary tumors arising in lateral aberrant thyroid tissue are reported.

2 In only 5 of the 20 cases of papillary carcinoma of the thyroid has death occurred as a result of the tumor.

3 In no instance has it been proved that either regional or distant metastasis took place.

4 In nearly half the cases of lateral aberrant thyroid disease the lobe of the thyroid on the affected side contained a tumor histologically identical with the lateral cervical nodules.

5 It is often difficult to distinguish between multiple lateral aberrant thyroid tumors and metastatic papillary carcinoma in cervical lymph nodes.

6 It is probable that many cases reported as papillary carcinoma of the thyroid with metastasis to the regional lymphatics are in reality benign papillary lateral aberrant thyroids with a co-existent benign tumor in the thyroid gland.

7 Tumors arising in lateral aberrant thyroid tissue are essentially benign. Only 2 of the 45 patients classified in the literature as having malignant tumors of lateral aberrant thyroid origin have been reported to have died as a result of recurrence of the tumor following operation. None of the 13 patients in this series has died as a result of lateral aberrant thyroid disease.

8 It has not been proved that either distant or local metastasis occurs from papillary tumors of lateral aberrant thyroid origin.

9 Surgery is the treatment of choice for all papillary tumors of thyroid and lateral aberrant thyroid origin. Roentgen therapy has not proved effective in their treatment.

I wish to express my indebtedness to Dr. Allen Graham for his aid in the interpretation of the histology of the tumors reported in this paper.

REFERENCES

- 1 ALBER, E. *Lehrbuch der speziellen Chirurgie* 1890, 233.
- 2 BAKER, ARTHUR F. Accessory tumor of the thyroid gland. *Tr. Path. Soc. Lond.* 1906, 4, 225-230.

- 3 BARNABO V Contribution to the knowledge of malignant tumors of the accessory thyroid glands Polclin (sez chir), 1910 17 112
- 4 BERGER P Branchiogenic epithelioma and aberrant epitheliomas of the thyroid (parathyroid epitheliomas) Ass franç de chir l roc verb 1897 11 15
- 5 BILLINGS A I and IAUL J R Tumors of lateral aberrant thyroids Bull Amer Clin Lab Penn Hosp 1923 9 27-44
- 6 CATTELL R B Aberrant thyroid J Am M Ass, 1931 9, 1761-1767
- 7 CHIVAT S Cancer of an aberrant lateral thyroid Oto-rhinolaryngol 1937 21 65-68
- 8 CLUTE H M and WARRIN SMITHS Cancer of the thyroid gland Am J Cancer 1931 15 2563-2582
- 9 D'ABREU A L Significance of lateral aberrant thyroids Lancet 1935 1406-1410
- 10 DUNHILL T I Carcinoma of the thyroid gland Brit J Surg 1931 19 83-113
- 11 EBERTS F M Lateral cervical aberrant thyroid Canad M Ass J 1933 29 3-33
- 12 FEDELI F Tumors of thyroid structure in the lateral region of the neck Arch ital di chir 1924 14 167
- 13 FORTY FRANK Tumor of aberrant lateral thyroid Brit J Surg 1933 20 695-698
- 14 GRAHAM ALLAN Malignant epithelial tumors of the thyroid Surg Gynec & Obst 1924 39 781-790
- 15 Idem Malignant tumors of the thyroid epithelial types Ann Surg, 1925 92 30-41
- 16 GREFENFELDER L and BETTMAN R B Carcinoma in lateral aberrant thyroid gland J Am M Ass 1922 78 91-799
- 17 GREFEMAN T J and RUSSUM B Aberrant thyroid tumors Nebraska M J 1936, 21 384-386
- 18 GUENZLER W E Papillary cystadenoma of the thyroid with glandular metastases In Diss Tuebingen, 190
- 19 HENTZ V G Lateral aberrant thyroid Med Rec 1935 142 416-418
- 20 HINTERSTOISSER H Contribution to the study of accessory thyroid Wien klin Wchnschr, 1888 1 651-653 680-682 701-703
- 21 KAMSLER A Carcinoma of an accessory thyroid Arch f klin Chr 1923 127 624-639
- 22 KAPLAN IRA I Benign metastatic bone involvement from thyroid tumors Am J Surg 1934 23 559-562
- 23 LAWTON S I Lateral aberrant thyroid glands Surg, Gynec & Obst 1933 56 696-699
- 24 LAZARUS J A, and ROSENTHAL, A A Lateral aberrant thyroid glands Ann Surg 1933 98 1023
- 25 MARTIN, WALTON Lateral accessory thyroid Ann Surg, 1914 60 379-380
- 26 MORITZ, A K and BAYLISS I Lateral cervical tumors of aberrant thyroid tissue Arch Surg, 1932 24 10 9-1043
- 27 NOORDHOF W Lateral aberrant thyroid tumors Nederl Tijdschr v Geneesk 1934 78 2378-2380
- 28 NORMANN, O Carcinoma of an aberrant thyroid Deutsche med Wchnschr 1921, 22 643
- 29 OSUFRIO O Polymorphocellular sarcoma of lateral aberrant thyroid Arch ital di anat e istol pat, 1934 5 935-959
- 30 PAIR I and MARTIN V On genuine lateral accessory thyroids Deutsche Ztschr f Chr 1906 9, 535-576
- 31 PEARFRETON JOHN DE J Treatment of carcinoma of thyroid gland Ann Surg, 1914 100 906-923
- 32 POOL, J H Carcinoma of accessory thyroid Ann Surg 1910 52 712-713
- 33 PROBST J C and KRISCH H Myxedema following removal of aberrant thyroid tissue New England J Med 1936 214 1101-1103
- 34 RUFEL, A Study of cystic cervical tumors Deutsche Zschr f Chr 1926 198 90-98
- 35 SCHRAGL V J Lateral aberrant thyroids Surg Gynec & Obst 1906 3 465-475
- 36 SCHARF O Ein Fall von Struma accessoria lateralis inferior carcinomatosa In Diss Leipzig 1904
- 37 SCHIFFISSER H C Bilateral and medial aberrant thyroid South M J 1936 29 1174-1178
- 38 TJOKRONOGORO S Papillary cystadenoma of the thyroid and aberrant lateral struma Geneesk Tijdschr v Nederl Indie 1934 74 200-206
- 39 VAN DEN WILDEBERG Contribution in the study of lateral aberrant thyroids Ann oto laryng 1934 (October) 949-966
- 40 VAN DEN WILDEBERG I and DUPONT V Lateral aberrant thyroids Rev belge sc med, 1931, 3 828-830
- 41 VIDGOTT I J Lateral aberrant thyroid report of case West J Surg, 1932 40 566-568
- 42 WOLFE M G Cancer of thyroid Interstate M J 1917, 24 1044-1049

CYSTIC HYGROMA OF THE NECK

Report of Twenty-Seven Cases

ROBERT E. GROSS, M.D. and C. FRED GOERING, M.D.
Boston, Massachusetts

HYGROMA of the neck is an uncommon endothelial lined cystic lesion of lymphatic origin which is encountered most often in infancy and childhood. Individual reports of this condition have appeared from time to time in the medical literature but few authors have had the opportunity to study many of these patients. We are therefore, prompted to publish our experiences with 27 such cases which constitute a larger group than ever reported from one clinic. According to Dowd the first report was made by Redenbacher in 1828. The name congenital cystic hygroma was first employed by Adolph Wernher in 1843. For a resume of the earliest publications the table compiled by Farr in Dowd's paper is worthy of note. The literature on this subject has been reviewed on several previous occasions. Dowd collected 91 cases which had been published prior to 1913. Vaughn added to this review collecting all cases up to 1934 bringing the total to 155. Goetsch in 1938 made an excellent pathological study of 12 personally observed cases. Adding a few isolated examples since the publications of Vaughn and Goetsch and including our own 27 patients approximately 225 cases have been reported to date.

Cystic hygromas have been described in other regions of the body particularly in the axilla and chest wall and less frequently in the groin. The cervical lesions however are much more common and constitute probably four fifths of all hygromas which have been studied.

CLINICAL DATA

Cystic hygromas may arise in many regions of the neck. They tend to occur most fre-

quently in the posterior triangle, lying behind the sternomastoid muscle occupying the supraclavicular fossa (Fig. 12) or extending over toward the crest of the shoulder (Figs. 1 and 3). In a much smaller proportion of cases the cyst may occupy the anterior cervical triangle, but when it does so there is a tendency for it to lie in a high position just beneath the angle of the jaw (Figs. 11 and 17) or to overlay the ramus of the mandible (Fig. 13). In Case 8 the cyst occupied a very high position and there was a projection into the floor of the mouth on the homolateral side. In a few striking examples of the condition a massive cystic structure may completely fill the lateral hollow of the neck and extend from the side of the head well down to the tip of the shoulder (Fig. 1) and it may even bulge to the subclavicular fossa and axilla anteriorly and to the spine of the scapula posteriorly. In 17 of our patients the swelling was on the left side and in the remaining 10 the right side was involved.

The size of the mass does not bear any definite relationship to the age of the patient or to the duration of the lesion. Indeed we have encountered some of our largest specimens in infants only a few weeks of age. The smallest cyst in our series is about 5 centimeters in length and 4 centimeters in diameter. Commonly they are described as lemon sized less often they are orange sized, and occasionally the mass is large enough to efface the normal contour of the neck on the affected side. When the lesion is small there appears to be only a single mass with a smooth well rounded external contour but in the larger growths a faintly lobulated surface indicates multilocular development. The cyst is usually not tense, and it commonly has a limpid consistency and poorly defined borders. While the overlying skin is essentially normal in

From the Departments of Surgery and Pathology of the Children's Hospital, the Peter B. P. Bingham Hospital and the Harvard Medical School.

texture, it may vary somewhat from its usual pinkish color and have a slightly bluish cast imparted to it by the underlying fluid. The thinness of the cyst wall and the clear colorless nature of the entrapped fluid permit the mass to be easily transilluminated. This latter finding is made in all of our cases excepting one in which there had been hemorrhage into the cyst cavity.

The local swelling is usually noted early in life. In our series 55 per cent were noted at birth, 75 per cent were discovered within the first year and 90 per cent were present by the end of the second year. The oldest age in which we have seen initial development of the swelling was 14 years. However, Hyatt, Goetsch, and others have cited instances with onset of symptoms in adult life.

Males and females are affected in about the same proportions in previously tabulated cases, but in our series there is a higher incidence in the males in the proportion of 16 to 11. Reference has been made in the literature to the tendency of the tumor to occur in the first born child of a family, but in 16 of our patients, in whom there are statements regarding the siblings, only 3 were first born children.

Our patients were in the following age groups: 2 were in the first month of life, 7 were 1 to 6 months of age, 2 were 6 to 12



Fig. 1. Case 2. Light-skinned infant. Cystic hygroma of the neck, which was present at birth.

months of age, 7 were 1 year of age, 2 were 2 years old, 3 were 4 and 6 years old, and 1 was 19 years old.

A physical examination of the cervical mass lends little additional information of value in most cases. The soft tissue swelling shows a shadow of rather uniform density with poorly defined borders (Figs. 2 and 14). The exact extent of the cavities can be demonstrated better by the injection of iodized oil, or better still an iodide solution, into the cyst as suggested by MacGuire and Vaughn. Roentgenological examination may aid in showing lateral displacement of the trachea or forward displacement of the upper esophagus. The most

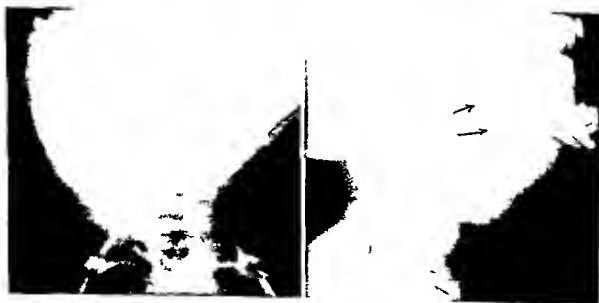


Fig. 2. Case 2. Anteroposterior and lateral roentgenograms of cervical hygroma. Compare with Figure 1. There is no lateral displacement of the larynx or trachea but the posterior pharyngeal wall (indicated by arrows) is pushed forward.



Fig 3 Case 3 a and b Pre-operative photographs. Five weeks old infant. Hygroma of the neck first noticed at birth. c Wound 8 days after surgical excision of hygroma. The skin loose and wrinkled but during the

course of subsequent weeks this redundancy spontaneously disappeared and a normal contour of the neck was re-established. d Same patient 6 years after operation showing normal contour of neck.

important use of roentgenological study is to determine the presence of mediastinal involvement which of course would have considerable bearing on the type of therapy to be instituted.

PATHOLOGY

Macroscopic findings. The hygromatous cyst when removed from the neck is a rounded ovoid or smoothly lobulated sac (Figs 4 and 8) which is thin walled and translucent. The paper thinness of the walls and the fluid content of the sac impart to the

specimen a soft consistency. The structure is usually monolocular but there may be side pockets separated by fibrous septa which freely communicate with the main cavity (Fig 13). Thus the puncture of any one of the accessory chambers results in a collapse of the entire specimen. One rarely encounters a group of closely adherent thin walled cysts which do not possess openings between their lumina but in one case (Fig 16) we have seen this form of the lesion. The walls of the cysts have a very low vascularity and the blood vessels which are present are always quite

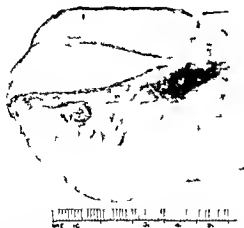


Fig 4 Case 3 Photograph of surgically removed cystic hygroma. The cyst is thin walled and is highly lobulated. The elliptical structure toward the left is an included portion of skin.

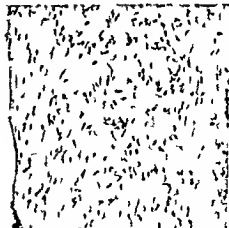


Fig 5 Case 3 Photomicrograph of hygroma. The cyst wall is comprised of rather dense connective tissue of low vascularity. The lining membrane consists of a thin endothelium. X170.



Fig 6 Reconstruction of a left jugular lymph sac from an 11 millimeter cat embryo showing relation of the lymphatic anlage to the cervical veins (after McClure and Silvester)

small. The cyst fluid is characteristically thin, clear, and usually colorless though it may possess a very slight yellowish tinge.

Microscopic findings. The fibrous wall is composed of connective tissue of variable cellularity (Fig 5). Collagen may be abundant and compact, or may be scanty and have a myxomatous appearance. Even in the absence of infection there are isolated lymphocytic cell infiltrations, and it is not uncommon to encounter lymphoid follicles with germinal centers. Blood vessels are mostly of capillary and arteriolar size, larger channels seldom being seen. A thin layer of flattened endothelial cells lines the cystic spaces (Fig 9). Occasionally a blood vessel, nerve, or small muscle bundle traverses a crypt or outpocketing of the main cyst cavity, and in each instance this traversing structure is surrounded by a single layer of endothelial cells.

Goetsch has added greatly to our understanding of the pathological processes in this lesion, particularly in reference to its manner of growth and propagation. According to his conception there are narrow outgrowths of cords of endothelial cells which grow between muscle bundles, nerve fibers, and other structures of the neck. While these cords are at

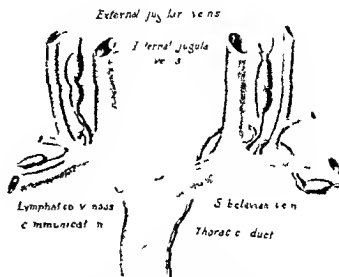


Fig 7 Sketch showing position of the lymphatic buds of the neck and their communications with the venous system as found in the embryo of a monkey (*Macacus nemestrinus* Inn) (after McClure and Silvester)

first solid, they later acquire a lumen by the accumulation of a lymph like fluid which forces apart the walls to form an endothelial lined sac, which either abuts against the main cyst cavity or else attains a communication with it. The continued collection of fluid in one of these side pockets or daughter cysts enlarges this wedge between the anatomical structures of the neck, so that eventually a muscle fiber, a blood vessel, or nerve becomes separated from its supporting structures and is surrounded by a layer of endothelial cells. In this way a small strand of muscle, an artery, etc., appears to finally traverse the cavity of a hygroma and may be atrophied by pressure from the surrounding fluid.

SYMPTOMS

As might be expected, a cystic hygroma usually gives little in the way of troublesome symptoms. Pain or local discomfort is rarely encountered unless secondary infection has occurred. The tendency of such a cyst to lie in a superficial plane of the neck permits it to bulge outward and thus be directed away from the important and deeply lying cervical structures. Hence it is rare to have interference with the normal functions of the brachial plexus, the great vessels, the esophagus, or the trachea. While the softness of the



Fig. 6 Case 5 Photographs of surgically excised cystic hygroma. Cyst measured 3 by 4 by 4 centimeters. Lower picture shows the thin wall which are characteristic of the sac and also the trabeculae which are often found coursing through the cavity.

tumor and its tendency to outward displacement usually protect the deep structures from damage. 2 of our patients had definite tracheal compression and another had interference with mastication by protrusion of the cyst into the floor of the mouth. Goetsch reports a patient who had respiratory embarrassment due to low tracheal obstruction by a prolongation of the mass well down into the mediastinum. The larger hygromas may be bothersome because they limit the free movements of the head and neck merely by their great size. In short then such a patient—or his parent—complains primarily because of the presence of a lump or the disfigurement which is associated with it.

The local mass is observed for a variable length of time before medical attention is sought. Some patients are directly referred by the obstetrician who has noticed the lesion at birth. It is not uncommon however that advice is not sought for many months or even several years because the rather innocuous appearance of the smaller lesions may excite



Fig. 6 Case 5 Photomicrograph of cyst wall showing the endothelial lining. $\times 100$.

little curiosity or anxiety. It is characteristic of some hygromas to lie rather dormant or to increase in size only slowly over a long period of time and then to have a sudden augmentation in size which brings the patient to the physician's care.

In 3 patients we have noted a relationship between the presence of an upper respiratory infection and the subsequent sudden enlargement of a previously existing cystic hygroma. Apparently the infection has led to plugging or partial obstruction of the normal lymphatic channels so that there is a backing up of lymph in the hygroma which causes it to enlarge. While we have no microscopic proof that there are communications between a hygroma and the normal lymphatic spaces of the neck, these related observations make us feel that such anastomoses do actually exist.

In 2 of the patients (Cases 11 and 21) noted in the preceding paragraph there was suppuration within the hygroma. In Case 21 a boy 3 years of age the cyst had been noted since birth but little attention had been paid to the mass until it had become infected. The local findings of course then changed to prevent all of the cardinal signs of inflammation combined with a severe systemic reaction and a pneumococcus bacteremia from which he eventually recovered. This case along with 2 others showing wound sepsis following partial excision of cysts have demonstrated that suppuration in these lesions is an extremely



Fig 10. Case 11. a Eleven months old boy with small recurrent hygroma on right side of neck. b Scar shows site of previous operation, at which time an incomplete removal

had been performed. c and d Photographs 4 years after partial excision, radium therapy, suppuration and incision and drainage.

dangerous complication, not only because of the rapidity with which it spreads through the local regions of the neck but also because of the great probability of bacterial invasion of the blood stream.

DIAGNOSIS AND DIFFERENTIAL DIAGNOSIS

Recognition of a hygroma rarely offers any real difficulty. Certainly, in those children in whom there is a large, lobulated, bluish mass which is covered by a very thin skin and which can be transilluminated, there should be no question in making a correct diagnosis. If the swelling arises in the supraclavicular fossa or elsewhere in the posterior cervical triangle, most of the other confusing lesions of the neck, including thyroglossal duct cyst and branchiogenic cyst, can be ruled out at once. However, when a small hygroma which is unilobular and smoothly rounded is found in front of the sternomastoid muscle these 2 other lesions may be differentiated only with difficulty. Points in favor of a hygroma are its ability to transmit light, the rather ill defined borders of the mass, and the soft and flabby consistency. Opposed to these findings, the cysts arising from the branchial system or thyroglossal duct are not as large, are more tensely filled, are apt to have a thicker wall, a better defined border, and transmit light only rarely. The branchiogenic cyst may be found anywhere along the anterior border of the sternomastoid muscle, particularly in its lower

one third, but attempts to move the cyst usually disclose some attachments to deep cervical structures (14) which are not such a prominent feature in the hygroma. The midline position of a thyroglossal duct cyst sets it apart from a hygroma, which, if it occurs in the midline, always has extensions well out to one side of the neck.

Dermoid cyst of the neck may occasionally be considered in the differential diagnosis. It usually can be excluded because of the superficial position of the lesion, its attachment to the skin, and the doughy and plastic consistency of the mass. Malignant neoplasms are at times subject to cystic degeneration, but there is always some remaining solid and palpable tissue which indicates the true nature of the swelling. A deeply seated hemangioma



Fig 11. Case 15. Eighteen months old girl with a left cystic hygroma which had been noticed for 6 months.



FIG. 16. Case 1. a and b Photograph of 1-year-old boy with a hygroma which had been present since birth. (This cyst subsequently became infected following an upper respiratory infection. Incision and drainage of the sup-

purating cyst led to complete disappearance of the lesion.) c and d The same boy taken 1 year later. No recurrence of hygroma following his respiratory infection and incision and drainage.



FIG. 17. Case 2. a and b Pre-operative photographs of 3-year-old girl with a hygroma which had been present for 2 years. c and d Postoperative photographs which were

taken 2 years after the surgical excision of hygroma, showing normal contour of the neck and an almost invisible cutaneous scar.



FIG. 18. Case 2. Photograph of surgically removed hygroma. There are multiple continuous, thin-walled cysts. The enlarged portion of the specimen at the right presented in the neck, and the slender part toward the left extended along the brachial plexus, into the axilla. (Case of Dr. John Homans from the Peter Bent Brigham Hospital.)

supported by our observations for in children who have been followed for several years we

have yet to see a patient in whom there has been a spontaneous disappearance of the mass. It is true that the cyst or cysts may decrease in size from time to time, but they will again refill and in general we have found that there is always a progression in size if the patient is followed over a long period of time. Hence our experience does not permit us to endorse the idea of expectant treatment and indeed there is much to be said again for it for the tendency of a hygroma to suppurate after respiratory infections makes it desirable that this serious complication be avoided by early excision of the cystic mass.

2 *Spontaneous regression following infection.* The introduction of an infectious agent into a

hygroma, of course, cannot be employed as a therapeutic procedure because of the lack of measures to control it. However, if suppuration does occur in a hygroma and the patient does not die of generalized sepsis, there is a strong likelihood that the hygroma will be cured because of destruction of the lining membrane by the inflammatory process. We have seen 2 examples of this in which, following tonsillitis and an upper respiratory infection, the purulent exudate accumulating in previously existing hygromas necessitated incision and drainage. Subsequent to the disappearance of the sepsis and the healing of the wound there has been no recurrence of these 2 cystic lesions in a period of 5 years during which they have been followed.

3 Aspiration treatment. As early as 1839, Arnott advocated the use of aspiration in small infants with large cysts who might not be able to stand the insults of a surgical procedure. In a 1 month old baby he performed repeated aspirations until the child was 4 months of age and surgical excision was possible. In only 1 instance have we attempted this and, after multiple needleings, the stagnant fluid within the cyst became infected. We have, therefore, discouraged the use of the procedure and would advise it only as an emergency measure for relief of pressure symptoms such as might occur with displacement of the larynx or with compression of the great neck vessels.

4 Injection of sclerosing agents. This has been suggested by MacGure and others. Harrower has advocated the use of sodium morrhuate because he felt that open operation carried too high a mortality rate. In his patient 2 cubic centimeters of 5 per cent sodium morrhuate were injected into the swelling. On the following day the mass had increased to one and a half times its previous size, but on the third day it began to shrink. Six days later a second such treatment was given and, though there was some postoperative local reaction, the mass had entirely disappeared in a month. After a study of pathological material, it would seem that the thinness of the lining of a hygroma would make the lesion almost ideal for injection therapy, because the sclerosing agent could be easily

diffused through the fluid medium and would not have to penetrate deeply into the tissues to destroy the endothelial layer. However, a word of caution must be inserted regarding this method of therapy. The hygroma is apt to dissect downward to the large vessels of the neck and partially or completely surround them. If, under such conditions, a necrotizing agent is introduced into the hygroma sac, it is possible that damage or thrombosis of the internal jugular vein or carotid artery could ensue. Furthermore, the introduction of a sclerosing fluid into the sac may be disastrous in certain cases in which there appears to be a definite communication between the hygroma and the venous system. What appeared to be such a connection was well demonstrated in Vaughn's patient who was studied roentgenographically after the introduction of iodized oil into the hygroma. X-ray plates taken immediately after the injection showed clearly the outlines and extent of the cystic swelling, but a plate one half hour later showed complete disappearance of the opaque medium which presumably had run off into some communicating vein. It is not difficult to contemplate the possible complications had a sclerosing solution been introduced into this lesion. Therefore, the likelihood of overlooking a small lymphaticovenous anastomosis leads us to discourage the injection therapy in all cases.

5 Use of setons. The use of a seton to attempt destruction of a hygroma has been advocated by several authors. Volker performed this procedure on a newborn child who died 16 days later. Smith reported 5 hygromas 4 of the neck and 1 of the chest, treated with setons consisting of a single thread of fine silk which was led through less prominent portions of the tumor, allowing some inflammation and induration to occur before withdrawing the thread. However, we agree with Gurlt that the procedure is dangerous on the grounds that diffuse uncontrollable suppuration and fatal infections are apt to occur.

6 Radium or roentgen ray irradiation. New, in 1924, was the first to treat a hygroma successfully with radium. Figs has been the principal proponent of radium therapy. He treated a series of 12 cases from the Mayo

Clinic employing from 3 000 to 7 000 milligram hours of radium (applications made at a distance of 2.5 centimeters using 2 millimeter lead screening) These were repeated at intervals of 2 or 3 months the average patient receiving 4 treatments Seven of these cases died of sepsis originating in the local lesion but 4 had been infected prior to the first application of radium Of the 5 patients who survived 3 were entirely cured and the 2 remaining were much improved

Radium has been employed in only 1 of our patients (Case 11) Following surgical excision there was a recurrence for which radium therapy was begun on the twenty second post operative day 65 milligrams of radium being used for 4 hours to each of 4 separate areas Within 2 months there was complete disappearance of the mass but 2 years later there was a recurrence The recurrent cyst became infected was incised and drained and has not reappeared in the subsequent 5 years during which it has been followed

X ray irradiation was employed in Case 20 of our series (Fig 13) Without previous therapy the treatment was given with diffuse exposure over the cyst employing 160 kilo volts 5 milliamperes tube distance of 40 centimeters for 26 minutes with filters of $\frac{1}{4}$ millimeter copper and 1 millimeter of aluminum This dose of approximately 250 r units was repeated 1 month later For the ensuing 2 months under observation there was no appreciable reduction in size of the mass and surgical excision was subsequently resorted to with success

In general then it may be stated that radium or x ray irradiation is not a very promising therapeutic measure and should be employed only for those cases in which there is mediastinal involvement or in which there is some other disease which contra indicates operative excision

7 Surgical excision The complete removal of a hygroma by surgical dissection has proved to be the most satisfactory method of treatment Many surgeons have evaded this undertaking believing that the young patient does not take an anesthetic well that the dissection is tedious and difficult and that the attendant mortality is high Contrary to

these statements it has been our experience that a child, even a newly born infant will tolerate ether anesthesia extremely well if administered by a capable anesthetist, that the excision of a hygroma can be performed with thoroughness if care is exercised that the resulting mortality is low and that permanent cure can be expected

In all cases we have employed ether or avertin (80 milligrams per kilogram) with ether and have found these extremely satisfactory Great muscular relaxation is not required and the necessary depth of anesthesia can be maintained over a long period of time without difficulty

In general the skin incision should be made in a direction which will later correspond to the normal folds of the neck If the mass is relatively small none of the overlying skin need be cut away but if the hygroma is large it may be desirable to remove an elliptical portion of the skin so that there will not be too much excess tissue when the cutaneous flaps are later brought together It is not necessary, however to plan on an accurate adjustment of the skin folds to remove wrinkles at the time of the wound closure for it has been amply demonstrated that large and disfiguring cutaneous folds will disappear rapidly and a pleasing contour of the neck will be reestablished in a few months time (Fig 3)

The dissection and removal of a hygroma is usually easy if patience is exercised and haste is avoided The overlying skin though tense and thin will readily separate from the underlying cyst If the wall of the cyst is closely followed blunt dissection will disclose a plane of cleavage leading almost entirely around the mass When the proper plane of cleavage is found and followed little bleeding is encountered for vessels running to the hygroma are quite small in size and few in number In general the large unilocular cyst is more easy to dissect than is the small multilocular lesion which is apt to be very adherent to surrounding structures

The cyst wall is little more than tissue paper in thickness and tends to tear easily hence it is important not to grasp the cyst with instruments but rather to hold it with the gloved hand or with a piece of moist gauze

Every effort should be made to keep the cyst intact, for as long as this is done the borders of the structure are readily definable, but once the mass has collapsed there may be prolongations outward between the muscles or vessels of the neck which will be cut across and be overlooked. Such an island of tissue which is left behind must necessarily act as a focus for recurrence of the lesion. Hence, meticulous technique must be employed to prevent rupture of the cyst and to avoid leaving bits of the endothelial lining if subsequent recurrence is to be avoided.

The removal of a hygroma may lead the operator extensively into the planes of the neck for it is the nature of the lesion to possess projections along the great vessels, between muscle bellies along the brachial plexus, into the axilla, or downward over the surface of the apical pleura. Such a behavior at once implies that care must be employed in order to insure that all of the contiguous and important structures of the neck might be left unimpaired. The internal jugular vein, carotid arteries, and branches of the brachial plexus are all large enough so that they can be easily identified and avoided, but the hypoglossal nerve and the lower filaments of the facial nerve are apt to be overlooked and severed with resulting distressing deformity. Mason and Baker have recommended that for tumors high in the parotid region it is safer to incise the skin well up behind the ear and first expose the facial nerve so that it can be identified along its entire course as the subsequent dissection proceeds anteriorly. In affirming this teaching, we would also add that whenever the dissection carries one in front of the sternomastoid muscle it is best to identify the spinal accessory nerve immediately so that it can be isolated and retracted to the upper border of the operative field.

The wound should be closed so that the edges of the platysma muscle are approximated. If this is done painstakingly, there will be little tendency for separation of the skin margins and the resulting cutaneous scar will be minimal and almost invisible (Figs. 12 and 17). Drainage of the wound is not necessary if hemostasis has been complete. The dressing must be carefully applied to insure

against accumulation of plasma and to promote adequate anchoring and healing of the undermined flaps of skin.

In nearly all cases the hygroma can be removed completely at a single operation. However, in an infant a few weeks of age with a very extensive growth, in whom operation is imperative because of respiratory distress, it would probably be best to plan a multiple stage procedure, removing only a portion of the growth at each stage.

The operative mortality should be low. In 25 of our patients surgical removal of the cyst was performed in 1 or more stages with 2 deaths. In one of these cases there was sepsis in the cyst prior to operation and probably excision should not have been undertaken. In the other fatal case suppuration occurred in the wound subsequent to the operation and the patient died of diffuse cellulitis of the neck and a resulting bacteremia. Recurrence of a hygroma should be rare if surgical excision is properly performed. In 3 of our patients only a portion of the hygroma was removed at the first stage, leaving the complete excision of the remaining cyst wall until a latter sitting. In every case following such multiple stage procedures all of the cyst could be finally removed and there was no recurrence. Likewise, in all cases in which the hygroma was completely excised in 1 operation, no patient had a recurrence.

SUMMARY

1. Experiences with 27 cases of hygromatous cervical cysts are reported. Cystic hygroma of the neck is a lesion occurring chiefly in infancy and childhood. It is first noticed in about half the cases at birth and is observable in 90 per cent of the patients by the end of the second year, yet the first onset of the swelling may not appear until later childhood or even adult life. The mass grows slowly and is composed of a thin walled cyst (or cysts) which is lined by an endothelial layer of cells and which is filled by a clear and colorless fluid. The specimen may vary in size from a few centimeters in diameter to one which may be larger than the patient's head.

2. The lesion is a congenital one and is presumably derived from rests of endothelial cells

which were split off and isolated from the fetal lymphatic system which arises from the primitive *lymphatic buds* of the neck.

3 The enlarging cyst may give symptoms from pressure on the trachea pharynx or other structure of the neck. It may be so large as to interfere with movements of the head and neck. In the average case there are no distressing symptoms but there is marked cosmetic disfigurement. There is a distinct tendency for a hygroma to suppurate particularly following an attack of tonsillitis or an upper respiratory infection. If bacterial invasion of a hygroma does occur there are profound constitutional symptoms for bacteremia may follow and the resulting mortality is very high. Therefore all hygromas should be removed in order to avoid the dangers of infection and its complications.

4 Treatment with the use of sclerosing fluids is probably hazardous because of the possibility of introducing some of the necrotizing agent into the general lymphatic or venous systems by way of small unsuspected communications. The use of radium or roentgen ray irradiation as a therapeutic measure has given irregular and disappointing results.

5 The treatment of choice is complete surgical excision. This can be accomplished usually in one stage except in those instances when the cyst is extremely large. The mortality from operative treatment should be very low and the incidence of recurrence should be negligible.

6 In the present series of 77 cases there were 2 deaths following operation both attributable to sepsis. In 1 of these the cyst was infected prior to operation, in the other the wound was infected subsequent to the surgical procedure. In the 72 patients who have been followed from 1 to 13 years after operation there has been no recurrence of the hygroma in any case. The cosmetic results following excision of the cysts have been excellent.

BIBLIOGRAPHY

1. ARNOLD J. Zwei Fälle von Hygroma colli cysticum congenitum und den fröhliche Beziehung zu dem Ganglion Intercaroticum. Arch f path Anat 1863 33 209.
2. ARNOTT. (Cited from Dowd.)
3. BAILEY H. The clinical aspects of branchial cysts. Brit J Surg 1923 10 563.
4. BIRKBEY. A contribution to the surgical pathology of serous cysts in the neck and axilla with illustrations and preparations. Med Times and Gaz 1868 2 79.
5. DOWD CHARLES N. Hygroma cysticum colli its structure and etiology. Ann Surg 1913 58 112.
6. FLETCHER F A. Radium in the treatment of multilocular lymph cysts of neck in children. Am J Roentgenol 1929 21 473.
7. FRASER JOHN. Surgery of Childhood. Vol 2 p 616. New York: William Wood and Company 1916.
8. GOETSCH L. Hygroma colli cysticum and hygroma axillare pathologic and clinical study and report of twelve cases. Arch Surg 1908 36 394.
9. GERTZ F. Ueber die Cysten-geschwulste des Halses. Berlin T C F Enslin 1833.
10. HASTEAD A E. and HARTZ M A. Lymphangioma cysticum. J Am M Ass 1899 32 33.
11. HARKOWER J G. Treatment of cystic hygroma of the neck by sodium morrhuate. Brit M J 1933 2 148.
12. HENNINGTON C. Lymphatic vessel of the cat. Mem. Wistar Inst Philadelphia 1911.
13. HUNT CHARLES N. Hygroma cysticum colli. J Iowa State M Soc 1932 22 406.
14. LADD W F. and GROSS R E. Congenital branchiogenic anomalies. Am J Surg 1938 39 234.
15. LUSCHKA H. Ueber die Drüsenartige Natur des sogenannten Ganglion Intercaroticum. Arch f Anat u Physiol 1862 2 403.
16. MCCUTCHIE D P. Cystic hygroma of the neck. Arch Surg 1935 31 301.
17. MARTIN LELONG. Cystic lymphangioma at the base of the neck with intrathoracic prolongation revealed by roentgenogram. Bull. Soc de pediat de Par 1933 31 410.
18. MASON S T. and BAKER J W. Cystic hygroma. South Chin M America 1931 21 1001.
19. McCLEURE C F W. and SILVESTER C F. A comparative study of the lymphaticovenous communications in adult mammal. Anat Rec 1909 3 334.
20. NEW G B. Hygroma cysticum treated with radium. Clin M America 1924 4 521.
21. REDENBACHER. Dis. Munich 1828. (Cited from Dowd.)
22. ROBERTS. Enormous hydrocele of the neck in a child. ed. Phila Med Times 1873 p 372.
23. SAEV F R. In Keibel F and Mall F P Vol 2 p 60. Manual of Human Embryology. Philadelphia J B Lippincott Co 1912.
24. SMITH T. On congenital cystic tumor. St. Barth. Hosp Rep 1866 2 24.
25. STORCH. Ueber das angeborenen Hygroma des Halses. J f Kinderkr 1861 37 68.
26. THOMPSON J E. and NEILLER A H. Lymphangioma of the neck. Ann Surg 1913 77 383.
27. VAUGHAN A M. Cystic hygroma of the neck. Am J Dis Child 1914 45 140.
28. VOLKER. (Cited from Smith.)
29. VON HERPEY CASABIANI G. Bilateral lymphangioma cavernosum in the neck. Zentralbl f Chir 1927 54 16 2.
30. WERNER A. Die angeborenen Kysten Hygrome und die ihnen verwandten Geschwulste in anatomischer diagnostischer und therapeutischer Beziehung. F 6 Cieson C F Haver 1843.
31. WENGELSKI R. Ueber die Halskysten und Cysten. Arch f klin Chir 1912 98 151.
32. WENSLER R. Cystic hygroma and other tumors of infancy. Surg Gynec & Obst 1917 25 428.

THE USE OF PROSTIGMIN METHYLSULFATE IN THE PREVENTION OF POSTOPERATIVE INTESTINAL ATONY AND URINARY BLADDER RETENTION

PHILIP A. MARDEN, M.D., and ERNEST G. WILLIAMSON, M.D., F.R.C.S., F.A.C.S.,
Philadelphia, Pennsylvania

THE possibility of postoperative intestinal atony and urinary bladder retention must be considered in all major operations particularly in those below the diaphragm. According to Jordan, some degree of urinary retention occurs in 50 to 80 per cent of patients after operation, similarly postoperative intestinal atony, as reported in the literature, also frequently occurs. Surgeons therefore welcome a method which successfully reduces or prevents the incidence of these complications. The importance of prostigmin¹ in the treatment of paralytic ileus is well established, in this report we are concerned only with the use of prostigmin as a preventive against postoperative intestinal distention and urinary retention. It is our belief that prostigmin is of definite value in preventing the postoperative occurrence of these two conditions.

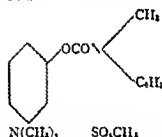
For years it has been known that physostigmine aids in overcoming intestinal distention, but the undesirable by effects of this drug prevent its routine use.

In 1931 White and Stedman determined that the physiological properties of physostigmine were dependent on the presence of the urethane group in the molecule, and they were able to demonstrate that alkyl substituted phenyl esters of carbamic acid in a manner similar to physostigmine. Following this lead, Aeschlimann and Reinert experimented with these esters and concluded that the dimethyl and the methylphenyl carbamic

esters of 3 hydroxyphenyl trimethyl ammonium methylsulfate were at least equally as effective in their action on the intestine as physostigmine.

The methylsulfate salt of the dimethyl ester was finally chosen as the most desirable compound and was made available for clinical use under the trade name of prostigmin.

The drug is non hygroscopic and is stable in aqueous solution. The molecular structure is less complicated than that of physostigmine, and is as follows:



Dimethyl carbamic ester of 3 hydroxyphenyl trimethyl ammonium methylsulfate

The ampul solutions of the drug are suitable for subcutaneous or intramuscular injection.

The activity of the body cells under the control of the autonomic nervous system is determined by the balance struck between the stimulation of the sympathetic and parasympathetic divisions of the system. The stimulation or drive of the parasympathetic nerves is effected or attended by the release of acetylcholine at the junction between the nerve termination and the receptor tissue, which acts as a bridge for the free flow of energy from effector to receptor tissue, resulting in cellular action. Choline esterase, also present at the junction, eventually destroys the acetylcholine after a physiological interval, and thus terminates the stimulation of the parasympathetic nerve endings. On the basis of these concepts, alteration of the acetyl-

From the Presbyterian Hospital, Philadelphia, Pennsylvania.
¹There are two salts of prostigmin—prostigmin methylsulfate and prostigmin bromide. Prostigmin methylsulfate is available in 1 cubic centimeter ampuls of 1:2000 solution and 1:4000 solution. To avoid burdensome detail hereafter in this report ampuls of the 1:2000 solution will be referred to as prostigmin regular and ampuls of the 1:4000 solution as prostigmin prophylactic. Prostigmin bromide is available as oral tablets and is used in the treatment of myasthenia gravis.

choline choline esterase balance or the use of drugs affecting their interaction stimulates or depresses parasympathetic activity. Prostigmin inhibits choline esterase and therefore is a cholinergic drug. In the postoperative patient there is apparently an autonomic imbalance with either sympathetic stimulation or parasympathetic paralysis. This hypothesis affords a physiological explanation of the relaxation of the intestinal and bladder musculature manifested clinically as intestinal atony and urinary retention. Prostigmin being a cholinergic drug arouses parasympathetic activity which is followed by increased tone and peristaltic activity of the intestinal and vesical musculature.

This effect of prostigmin on intestinal tonus has been demonstrated experimentally (22). The action on the bladder is less evident. Myerson has shown that the administration of prostigmin combined with acetyl-beta-methylcholine is followed by very marked stimulation of the bladder musculature; however the use of the combination appears to have dangers which outweigh the clinical advantages in light of present knowledge.

Prostigmin in the therapeutic dosages ordinarily employed in postoperative atony and retention (i.e. 0.25 to 1.0 mgm) is free from undesirable effects on the cardiovascular system, the pupil, the sweat glands and the salivary glands (6). Toxic symptoms in the normal human being after the oral ingestion of 90 milligrams of prostigmin have been described by Goodman and Bruckner as follows: bradycardia, intestinal discomfort and activity, shock, skeletal muscle activity, spasm of accommodation and miosis. Atropine was found to be a specific antagonist.

Prostigmin in the prevention and treatment of intestinal atony has been the subject of numerous reports in the literature. One of the most recent reports comes from Harger and Wilkey who employed prostigmin with complete satisfaction in 175 postoperative abdominal cases. These authors used the 1:4000 solution at 2 hour intervals with no untoward after effects.

There are relatively fewer articles on the use of prostigmin in postoperative urinary bladder retention. Duschl was one of the first

to be impressed with its value in this condition. Several other investigators have found prostigmin an aid to micturition in the post-surgical patient.

We used prostigmin in a series of 253 operative cases of which 250 were studied for intestinal distention and 247 for urinary bladder retention. Three of the cases involved such surgical procedures as first stage colostomy and could not be studied from the standpoint of intestinal atony and 6 involved operations on or near the bladder where catheterization was routine.

The intestinal group was divided into those cases in which there was no distention detectable, those with slight and brief periods of distention, those with moderate distention lasting up to 36 hours and those with severe distention lasting more than 36 hours.

The diagnosis of urinary retention was based on the necessity for catheterization which was done at the eighteenth hour after operation or before that time if the patient complained of discomfort.

The intestinal distention series and the urinary retention series were each subdivided into three groups (A) those receiving prostigmin both before and after operation, (B) those receiving prostigmin before operation only and (C) those receiving prostigmin after operation only.

In groups A and B when possible three injections of prostigmin were given at convenient intervals over the period of 18 hours immediately preceding operation. In groups A and C the administration of prostigmin was started within 4 hours of the patient's return from surgery and continued at 4 or 6 hour intervals for a total of 4 to 6 doses or more if distention or retention appeared imminent. A soft rubber tube was inserted into the rectum routinely for a period of one half to one hour after each injection of prostigmin. The results are given in Tables I and II.

We began our investigation using the 1:2000 solution of prostigmin (prostigmin regular) in 1 cubic centimeter doses. Later a supply of 1:4000 solution (prostigmin prophylactic) became available. We continued the trials using the latter strength without bow ever, increasing the number of doses or de

TABLE I — POSTOPERATIVE URINARY RETENTION—247 CASES

	Prostigmin given		After operation only
	Both before and after operation	Before operation only	
No catheterization	87	13	134
Catheterized once	2	0	2
Catheterized more than once	1	0	8
Percentage catheterized	3.3	0	6.9

creasing the interval between injections Prostigmin prophylactic (1:4000) was equally as effective as prostigmin regular (1:2000) in preventing distention and retention of urine (Table III)

In groups A and B combined, in which prostigmin was given before operation, the incidence of intestinal distention was reduced to 5.7 per cent. In group C in which prostigmin was given only after operation, the incidence of distention was 14.4 per cent. No ill effects resulted from the continued use of prostigmin after end-to-end anastomoses and other types of gastro intestinal surgery. It was interesting to note at the operating table how much better the tone of the bowel was in those patients who had received prostigmin before operation.

In the urinary retention series, those patients receiving prostigmin before operation required catheterization in but 3.9 per cent of cases, while 6.9 per cent of those receiving the drug only after the operation had to be catheterized. It was observed during the earlier months of study that some patients, during the twelfth and eighteenth postoperative hours, experienced a desire to void but were unable to do so until toward the end of that period. To aid these patients one of us (E. G. W.) devised the plan of giving each patient, in addition to the regular routine doses, a 1 cubic centimeter injection of 1:2000 prostigmin every hour for a total of three injections. This resulted in the most gratifying response. Most of the patients voided after the first or second injection and in no case was catheterization necessary.

No patient in the combined series exhibited any marked lowering of the blood pressure or

TABLE II — POSTOPERATIVE INTESTINAL ATONY—250 CASES

	Prostigmin given		After operation only
	Both before and after operation	Before operation only	
No distention	85	13	125
Slight distention	3	0	11
Moderate distention	3	0	7
Severe distention	1	0	3
Percentage with distention	6.6	0	16.8

TABLE III — RESULTS ACCORDING TO STRENGTH OF PROSTIGMIN SOLUTION

	Total cases	Distention	
		Cases	Per cent
Prophylactic (1:4000) only	90	11	12.2
Therapeutic (1:2000) only	140	15	10.7
Both prophylactic and therapeutic	11	1	9.1
	250	27	
	Total cases	Catheterized	
		Cases	Per cent
Prophylactic (1:4000) only	93	5	5.4
Therapeutic (1:2000) only	138	7	5.1
Both prophylactic and therapeutic	11	2	18.2
	247	14	

slowing of the pulse. There was no appreciable degree of miosis, impairment of accommodation, or sweating. This is in agreement with the findings of other investigators. One patient, 4 months pregnant, received the routine prostigmin dosage without any disturbance of the gravid state. Some patients received as many as twenty-four 1 cubic centimeter doses of 1:2000 prostigmin. Subjective complaints were rare, and "gas pains" were very infrequent. Only one patient, a graduate nurse, experienced abdominal discomfort directly referable to the drug itself. This girl complained of mild upper abdominal pain lasting for a few minutes after each injection had been given. The pain ceased as soon as the administration of prostigmin was concluded.

CONCLUSIONS

Prostigmin given prophylactically both before and after operation is effective in reducing the incidence of postoperative intestinal atony and urinary bladder retention

The prophylactic (14000) strength of prostigmin appears to be as effective as the therapeutic (12000) strength in preventing postoperative distention and retention of urine

If the usual prophylactic routine seems insufficient to control urinary retention the hourly administration of 1 ampul of 12000 prostigmin for three consecutive injections gives the desired result

In the series reported we found no contra indications to the use of prostigmin and we observed no untoward results. A case in which there was mild abdominal discomfort following the administration of prostigmin is described

REFERENCES

1. VESCHLIMANN J A and REINFERT M. The pharmacological action of some analogues of physostigmine. *J Pharmacol & Exper Therap* 1931 43 413
2. BAKER W W and ANDRIS E C. Pre operative and post operative care of patients undergoing renal surgery. *Surg Clin N America* 1930 16 1171
3. BECK W. Prophylaxis with prostigmin in gynecologic operations. *Muenchen med Wchnschr* 1932 70 349
4. BROS W. Report of a case. *Brit M J* 1937 2 581
5. BROS W and KISSKOWSKI P. Experimental studies on action of prostigmin on bladder with clinical cases. *Polska gaz lek* 1933 12 401
6. BRIDA I. Treatment of postoperative intestinal ileus and urinary retention. *Chujalmed* 1935 16 90
7. CARMICHAEL I A, FRAZER F P, MCKELVEY D and WILKIE D. The therapeutic action of prostigmin. *Lancet* 1934 1 942

8. DAMESHEK W, LOMAN J and MYERSON A. Human autonomic pharmacology. *Am J M Sc* 1939 195 88
9. DAVIO W I. Paralytic ileus cured with prostigmin. *Lancet* 1935 1 1100
10. DE SAINT (FORCES). A new enterokinetic. *Scalpel* 1932 8, 824
11. DUSCHL L. Clinical experience with prostigmin. *Muenchen med Wchnschr* 1933 80 404
12. HORSO. A specific remedy for intestinal and bladder atony. *Riv ital di terapie* 1934 2 63
13. FEMACALLET. Treatment of postoperative intestinal atony with a new peristaltic. *Atti e Mem d Soc Lombarda di Chir* 1933 1 1040
14. COODMAN L S and BRILCNER W J. Therapeutics of prostigmin. A warning concerning its oral use. *J Am M Ass* 1937 109 965
15. HARGER J R and WILKIE J E. Management of postoperative distention and ileus. *J Am M Ass* 1935 110 1585
16. HENDLER H B. Use of prostigmin as prophylactic against abdominal distention. *West J Surg* 1931 45 458
17. HUNER K. Prostigmin in surgery. *Deutsche med Wchnschr* 1936 62 707
18. JORDAN C C. Postoperative urinary retention. *Ann Surg* 1931 98 123
19. LEVY W R and AXELMAN F I. A modern method for prevention of postoperative distention. *Am J Surg* 1936 32 302
20. MYERSON A. Human autonomic pharmacology. VII. Theories and results of autonomic drug administration. *J Am M Ass* 1938 110 101
21. LOP A and ISMAELI G. Prostigmin in the therapy of intestinal atony and postoperative retention of urine. *Chujalmed* 1933 14 370
22. POTUSCHILLO F. A new peristaltic. Prostigmin. *Roche Med Jlin* 1937 28 365
23. SIEGLER M. Prostigmin. *Roche Schweiz med Wchnschr* 1933 63 366
24. SCHLAEPFER K. Relief of postoperative intestinal atony with prostigmin. *West J Surg* 1936 44 437
25. SZUBINSKI A. The action of prostigmin. *Zentralbl f Chir* 1933 59 2439
26. UZANSKI M I. A new treatment for paralytic ileus. *Mirois M J* 1936 6 567
27. WHITE A C and SHEDMAN E. On the physostigmine like action of certain synthetic urethanes. *J Pharmacol & Exper Therap* 1931 41 259

ECTOPIC PREGNANCY

A Review of Three Hundred Ten Operative Cases

LOUIS LANGMAN, M D and MYRON GOLDBLATT, M D, F A C S,
New York, New York

THIS is a study of 310 cases in which patients were operated upon for ectopic pregnancy, or operated upon for some other condition but with an ectopic pregnancy found at operation, during a 7 year period from 1930 to 1936 inclusive from the gynecological service at Bellevue Hospital. All of these patients presented a history and symptoms warranting admission to the hospital, even though immediate operation was not always performed, and varying periods of observation were frequently necessary before a diagnosis was established. In spite of careful observation, sometimes rather prolonged, the diagnosis was often incorrect as will be shown.

ANALYSES OF DATA

Of the 310 cases, 9 were under 20 years of age. Eight-two were from 20 to 25 years, 96 from 25 to 30 years, 79 from 30 to 35 years, 35 from 35 to 40 years, and 9 were over 40 years of age. It is obvious that the majority of cases occurred between the ages of 20 and 35 years (257). The incidence under 20 and over 40 years was comparatively low.

There were 36 colored patients, 273 white and 1 yellow. It is interesting to note, and perhaps of some significance, that the incidence of ectopic pregnancy in the colored race is approximately 11 per cent, although the total admission to the gynecological service runs close to 40 per cent with an extremely high incidence of salpingitis. An explanation of this observation is a matter for speculation.

The most common infections and in order of frequency were measles, 127, whooping cough, 56, mumps, 42, and pneumonia, 24. There were 115 patients who had had no pre-

vious operations, 50 who had had 1 or more curettages, 46 who had had appendectomies, 37 who had had previous abdominal gynecological operations, and only 9 who gave a definite history of previous ectopic pregnancy. From these figures we can conclude that there is an unusually high incidence of previous lower abdominal surgery, not including previous ectopies. A definite history of pelvic infection was obtained in 59 cases, 42 of which were gonorrheal, 10 postpartum, and 7 post-abortum. It is very likely that lesser grades of pelvic infection, either gonorrheal or otherwise, were never severe enough to be considered by the patient and therefore not obtained in the history. In spite of this, there is still an incidence of less than 20 per cent of pelvic infection.

In 99 instances, the interval since marriage was not stated, 20 patients were not married, and in 10 the interval was less than 1 year. It is interesting to note that 66 had an interval of more than 10 years, and 58 more than 5 years since marriage, a total of 124 out of 211 who were married 5 or more years.

The opinion is prevalent that a period of complete or relative sterility exists prior to the occurrence of an ectopic pregnancy. It is difficult to evaluate correctly all our figures, because of the 77 who were not previously pregnant, we are unable to say how many practiced contraception or were unmarried. More than one third (119) occurred in less than 5 years following a previous pregnancy. In more than one sixth (53), 5 years or more elapsed since the last pregnancy. In about 10 per cent (27), the interval was less than 1 year. From our observations it would seem that overemphasis has been placed on the sterility period prior to the occurrence of an ectopic pregnancy. Practically an equal number of patients showed an incidence of less

From the Department of Obstetrics and Gynecology, New York University College of Medicine and the Obstetrical and Gynecological Service of the Third (New York University) Surgical Division, Bellevue Hospital.

than 2 pregnancies (154) as showed more than 2 pregnancies (155). The number of previous pregnancies appears to bear no relation to the incidence of ectopic pregnancy. In our 240 ectopic pregnancies 128 patients gave a history of 1 or more abortions spontaneous induced or both. There were 86 spontaneous and 56 induced abortions. While the number of spontaneous abortions outnumber the induced abortions by 50 we are not convinced that either play a role in the causation of ectopic pregnancy. The same we feel is true as regards term pregnancies.

The greatest number of patients complained of a colicky pain severe in degree and irregular in continuity. In the next larger group the pain was lancinating in character moderate in severity and constant. As regards radiation of pain it is interesting to note that in approximately two thirds of the patients (119) the pain was generalized over the entire abdomen next in frequency being the right or left lower quadrant with comparatively few radiations to one or both shoulders. The following shows the exact figures.

The type of abdominal pain was colicky in 170 patients lancinating in 107 aching in 41 no abdominal pain present in 4 and no report was given for 5. The pain in 156 patients was severe in 76 moderate in 51 only slight and in 8 patients the degree of abdominal pain was not reported. Two hundred nineteen patients reported that the pain was irregular 70 that it was constant 9 that it was rhythmic and 16 did not state anything relative to the continuity of pain. Pain radiated to one or both arms in 6 patients one or both shoulders in 65 to the left or right abdominal quadrant in 79 epigastrium 16 back 37 chest 13 rectum 11 and vagina 4. Five did not complain of any radiation of pain.

Nausea was the most frequent general symptom (16 cases). Vomiting was next (140) followed by weakness (135). Fainting was the least frequent but did occur in more than one third of the cases (91). When fainting did occur the diagnosis of ectopic pregnancy was usually correct. In the cases studied there were only 5 instances of actual fainting in whom no ectopic was found. It

is very important to note that no general symptoms were present in 32 instances. In 56 cases there was a definite history of frequency and dysuria associated with the onset of the symptoms. Half of this number (28) presented bowel symptoms particularly pain on defecation.

Although more than half of our cases (160) were admitted to the hospital 50 or more days after their last menses 56 cases sought admission 50 days or less from the time of their last menstrual period. It is difficult to ascribe a clear-cut pattern to the type duration and amount of bleeding in our series of ectopics. Bleeding varied from spotting of only a few hours duration to many weeks many times with an interval of no bleeding. The quantity was from scanty to fairly brisk hemorrhage with all gradations between. Very few cases gave a history of having passed a decidua cast. In 41 cases the bleeding was continuous with the last menstrual period. In 9 cases there was no bleeding whatsoever. Pain was experienced within less than 20 days from the last menses in more than 75 per cent of our series. There were 60 cases in which pain began with the last menses and continued more or less. In 6 instances only was there no pain present. It is difficult to correlate the occurrence of the pain with that of the bleeding since both were variable.

A temperature of over 101 degrees was uncommon. A pulse rate of over 120 on admission was infrequent in spite of the fact that 150 patients had 500 cubic centimeters or more of free blood in the peritoneal cavity and 55 patients were in surgical shock. There was nothing significant about the respiration. In more than two-thirds of the cases the blood pressure was normal. There were 55 instances of shock.

Distention of the abdomen was present in one third of the cases. An abdominal mass was felt in slightly more than one tenth of the cases. Tenderness was noted in both lower quadrants in more than one third of the patients generalized tenderness in slightly less than one fourth the number. In slightly less than one fifth there was no tenderness. Cullen's sign was reported only twice although looked for constantly. The cervix was

tender on motion in approximately two-thirds of the cases. The uterus was normal in size and position in approximately the same number. In more than three-fourths of the patients an adnexal mass was palpable and nearly always tender. In more than half the cases there was fullness or a boggy or doughy mass in the cul de sac which was practically always tender. The size of the adnexal mass varied from 4 centimeters to 8 centimeters, rarely more.

Unfortunately in more than one third of the cases a red blood cell count was not done. In 199 cases in which the red count is reported, 160 had a count of 3,000,000 or more, and in only 5 cases was the count less than 2,000,000. In 250 cases the hemoglobin was 60 per cent or more. More than one third of the patients had a white blood count within normal limits, and in another third, the white blood count ranged between 10,000 and 16,000. In less than one fifth of the cases did the white blood count go over 16,000. The differential count showed 70 per cent to 80 per cent polymorphonuclears in one third of the cases, and in more than one third, 80 per cent to 90 per cent. In only one tenth of the cases were the polymorphonuclears 90 per cent or more.

In approximately two thirds of the cases, the sedimentation rate was 60 minutes or over (Linzenmeier). In one fifth of the cases the rate was 30 to 60 minutes. In only a small group, less than 8 per cent, was the sedimentation rate less than 30 minutes. It is important to note that where the sedimentation rate was 30 minutes or less, the diagnosis of ectopic pregnancy was usually not confirmed at operation.

In those cases in which the diagnosis is not obvious and the symptoms do not demand immediate operation, we feel that the Aschheim Zondek test is of the greatest aid in arriving at a correct diagnosis. The test was done in 69 cases, and suggested but not done in 6 cases. In 50 instances the test was positive, and in 19 cases it was negative. Of the positive cases, 45 were ectopics, 3 normal pregnancies, 1 complete abortion, and 1 chronic salpingitis, all of which were operated upon for ectopic pregnancy. It was noted

that in our series there was only 1 false positive (2 per cent). Of the 19 negative tests, 6 were not ectopic (32 per cent), and 13 were ectopics. Of these 13 ectopics, 5 gave a history of bleeding more than 6 weeks. In those cases in which the test was suggested but not done, half were ectopics, (3 ectopics and 3 not ectopics). Excluding abortions and normal intrauterine gestation, in doubtful cases a positive Aschheim Zondek test always means ectopic pregnancy. The converse, i.e., a negative Aschheim Zondek test is not true, for an old ectopic may be present with a negative test, depending on the time elapsed from the onset of symptoms to the performance of the test. However, in the face of a negative Aschheim-Zondek test, one must be more cautious in making the diagnosis of ectopic pregnancy for the chances of error are about one third (6 in 19 cases or 32 per cent).

TABLE I—ACCURACY OF DIAGNOSIS COMPARED WITH ASCHHEIM ZONDEK TEST

	1930	1931	1932	1933	1934	1935	1936	Total
Positive Aschheim Zondek	0	7	7	4	6	14	11	50
Ectopic	0	7	5	4	6	12	11	45
Not ectopic	0	0	2*	0	0	2†	1‡	5
Negative Aschheim Zondek	0	2	2	1	7	6	2	19
Ectopic	0	1	2	1	5	4	2	13
Not ectopic	0	1	0	0	2	2	2	6

*These 3 patients diagnosed as positive ectopics were normal pregnancies.

†These 2 patients diagnosed as positive ectopics proved at operation to be 1 case of complete abortion and 1 case of chronic salpingitis.

‡Five patients of these 13 ectopics gave a history of bleeding more than 6 weeks.

§Five of these patients had salpingitis and 1 had an ovarian cyst.

Of the 240 ectopics, 84 had less than 500 cubic centimeters of free blood in the peritoneal cavity, 96 had from 500 to 1,500 cubic centimeters and 34 had over 1,500 cubic centimeters. It is interesting to observe that only 35 of these patients were in shock on admission or any time prior to the operation. Our table includes all operative cases (310), all of which were not ectopics. This explains the large number (92) with no free blood in the peritoneal cavity.

The fundus was normal in size in nearly twice as many instances as it was enlarged, and then only slightly enlarged. In about 10 per cent the uterus was retroverted, the re-

mainder were normal in position. The right tube was involved in 1,30 cases the left tube in 110. The opposite tube was seen to be normal twice as often as pathological (145-71).

Colpotomy was performed only 4 times and curettage 14 times. The curettage however was misleading in nearly half of those cases in which it was done. A diagnosis of incomplete abortion being made and the patient allowed to return home only to be readmitted with a ruptured ectopic or a curettage was done for incomplete abortion and a diagnosis of ectopic pregnancy made the patient was then subjected to a laparotomy and salpingitis was found at operation. In 17 cases 1 tube was removed in 92 cases 1 tube and 1 ovary was removed. An attempt is made whenever possible to leave the ovary on the side involved.

There were 20 single transfusions and 1 double transfusion before operation. Forty-nine patients received 1 and 3 received 2 transfusions after the operation. In all 99 transfusions were given. There were 38 post-operative complications of which 24 were wound infections and 17 pneumonia. These comprised the majority of the complications.

More than half of our patients were in the hospital less than 4 weeks. Only one sixth of the cases were hospitalized 25 days or more. Eight patients of the 310 operated upon died. One half died from hemorrhage and shock either on the operating table or a few hours after operation. During the last 3 years of our study no deaths occurred. It is interesting that although pulmonary embolism occurred 1 times only 1 patient died from this complication. Pneumonia which was present in 17 cases caused only 1 death (Table II).

The importance of anesthesia both as regards method and administration must not be overlooked. The use of cyclopropane in recent years by a well organized and efficient anesthesia department has resulted in the saving of many lives. We attribute this to the careful selection of type of anesthesia and efficiency in the administration of it.

The most frequent difficult differential diagnosis is that of chronic salpingo-oophoritis. The diagnosis of ectopic pregnancy with this finding at operation is almost 3 times as

TABLE II—MORTALITY CAUSES

No.	Number	Cause of death	Time el. med. after operation
01	1	Pulmonary embolism	5 days
	1	Hemorrhage and shock	4 hours
1031	1	Hemorrhage and shock	1 hour
	1	Hemorrhage and shock (fatal)	3 hours (fatal)
	1	Hemorrhage and shock	2 hours
	1	Acute myocardial infarction (fatal)	24 hours
05	1	Paratyphoid fever	4 days
	1	Postoperative pneumonia and distention	9 days
Total	8		

frequent as the reverse. In these cases where the diagnosis is difficult we feel that the Aschheim Zondek test is indispensable.

A total of 2,468 laparotomies was done 310 of which were performed for ectopic pregnancy. Of this number 218 diagnoses were correct while 92 were wrong. Seventy patients diagnosed as ectopics revealed the following at operation: acute salpingitis 10 chronic salpingitis 31 ovarian cyst 5 normal pregnancies 6 appendix 1 parametritis 1 retroversion 1 incomplete abortion 1 post-operative adhesions 1 rupture of broad ligament 1 and no gynecological pathology 2.

Twenty-two patients were diagnosed as follows but at operation ectopic pregnancy was found: acute salpingitis 1 chronic salpingitis 11 ovarian cyst 4 fibroid tumor 2 surgical abdomen 1 acute appendix 1 endometritis 1 and threatened abortion 1. Twenty-six operations performed were necessary while 66 operations were unnecessary.

As has been previously shown more than two thirds of our cases occurred in the ampullary portion of the tube. More than half of these were internal ruptures. There were only 10 interstitial pregnancies and these all ruptured externally. There was only 1 ovarian pregnancy and this was primarily in the ovary. This case was studied and reported by Doctor Studdiford.

There was microscopic evidence of inflammation in slightly more than half of the ectopics chronic inflammation being by far the most common finding (114). We have no

definite record of abscess formation due to secondary infection in a single instance. In somewhat less than one third of our cases (73), there was no pathological evidence of inflammation. Although endometriosis, as a causative factor of ectopic pregnancy, has been emphasized by some writers, we were not able to substantiate this finding.

SUMMARY AND CONCLUSIONS

1 There is an unusually high incidence of previous lower abdominal surgery.

2 Although a history of pelvic infection was obtained in less than 20 per cent of our cases, microscopic examination of the tubes showed evidence of inflammation in more than 50 per cent.

3 Overemphasis has been placed on the sterility period prior to the occurrence of an ectopic pregnancy.

4 The number of previous pregnancies or their termination bear no relation to the incidence of ectopic pregnancy.

5 Pain is most often colicky, severe, irregular, and generalized over the abdomen. Radiation to one or both shoulders is relatively uncommon, but significant when present.

6 Nausea and vomiting are far more frequent than fainting. The latter, when present, is pathognomonic.

7 Pain and bleeding in relationship to the last menstrual period is extremely variable as

to occurrence, duration, and amount, and often difficult to correlate.

8 Physical findings without laboratory aid are often misleading.

9 The sedimentation rate is most often normal in spite of an elevated white count.

10 In doubtful cases, the Aschheim Zondek test (or Friedman modification) is indispensable. Excluding abortions and normal intra-uterine pregnancies, a positive test always means ectopic pregnancy.

11 The use of repeated whole blood transfusions before, during, and after the operation should reduce the mortality to less than 2 per cent.

12 The percentage of error in our series was 29.7. The commonest cause of error was chronic salpingo oophoritis. This, we believe, can be greatly reduced by the more frequent use of the Aschheim Zondek test.

13 More than two thirds of the cases of ectopic pregnancies in our series occurred in the ampullary portion of the tube, as has been reported by other investigators.

14 Pathological examination of the tubes removed revealed inflammatory reaction both acute and chronic in over 50 per cent of the cases. The relationship this finding bears to the etiology and pathogenesis, we are not ready to state. Endometriosis as an etiological factor was not observed in a careful pathological study of our series.

A PRACTICAL AND CLINICAL TEST FOR LIVER RESERVE

DEAN MACDONALD M.D. St Catharines Ontario

FROM a surgical standpoint it would always be important to know the working capacity of the liver if it could be told. The value of such information is obvious. This is particularly true when it is a factor in the diagnosis and prognosis of such cases as pancreatic disease, affections of the intrabepatic or extrabepatic biliary tree, operations in the upper abdomen and metastatic lesions of the liver. Such lesions if they could be demonstrated would indicate the possible futility of surgery. Its greatest value and application however is in the too often neglected and ignored liver dysfunction which is always a constant accompaniment of biliary tract and thyroid pathology. It is recognized by too few that diseases of the gall bladder and thyroid is *always* associated with liver pathology or at least with functional changes which produce a loss of reserve power. In fact liver pathology often precedes and produces gall bladder trouble. Failure to recognize this fact is the cause of a great deal of the operative mortality in general practice.

Cholecystectomy is the second most common operation performed on the human and yet the average global mortality is from 10 to 17 per cent with a high of 25 to 30 per cent and a low of 3 to 5 per cent. These figures are based on replies to an inquiry sent to hospitals in the smaller and medium size cities listed in the *Directors of the American College of Surgeons*. This death rate does not apply to the larger centers or clinics. However, the smaller hospitals and the general practitioners throughout the country do the greater amount of work so that this is the mortality that should be considered rather than the mortality of specialists in teaching centers. Why is it that a condition so prevalent and whose operative treatment is rarely an emergency should have a mortality so high? The answer may be found partly in the liver and partly in the heart—but the relationship of gall bladder and heart is another question. Certainly the

liver is to blame in many instances. Even when a surgical death is due to hemorrhage the liver is indirectly responsible. No other common surgical procedure carries such a high mortality except perforated appendix and this is associated with a peritonitis. The late Lord Monrohan once said that surgery has now been made safe for the patient and that it remains for us to make the patient safe for surgery. We cannot be considered faithful trustees of our patients' future health if we do not realize this fact. If we do we will always determine before operation (as well as we can) whether any particular liver may or may not stand the strain of operation after operation.

Regarding the thyroid it is a well known fact that the feeding of excessive amounts of thyroid extract to animals will completely diminish the store of glycogen in the liver cells and also that the injection of blood from thyrotoxic patients will do the same thing. This is a partial explanation of why the so called liver shock death following gall bladder surgery resembles so closely and why some consider it the same as the thyroid crisis which also results in death. It shows too the importance of knowing liver function in thyroid patients, and why glucose therapy is of such value in thyroid surgery.

Every operative procedure undertaken, even the setting of a fracture or a tonsillectomy is a potential death but this applies particularly to operations on the biliary tract. *Every liver with a diseased gall bladder is damaged before operation and every operation decreases the ability of any liver to function with the maximum reserve*—hence the importance of knowing how much of this maximum reserve is available in case of need. If the surgical mortality of this and other conditions, is to be lowered then everyone must be considered a potential death and liver reserve tests done on each one. In the presence of an abnormal response as will be

shown, operation should be postponed until it is normal, or until an honest effort has been made to bring it to normal.

Cline has shown that a liver can lose from 10 to 15 per cent of its efficiency for each degree loss in temperature and also that the loss at operation may, in rare and extreme cases, reach 3 degrees so that there is a potential loss of 40 to 45 per cent of liver function by only opening the abdomen. This does not take into account shock, trauma, or anesthesia. If a liver can lose 40 to 45 per cent of its function by only opening the abdomen, and it may lose another 30 to 40 per cent by shock, trauma, anesthetic, and other incidental happenings at operation (a possible total of 80 to 85 per cent), then it is obvious that, if the loss of efficiency is maximal, there can be only one result if that liver has less than 85 per cent of its functioning ability to begin with (i.e. if it has lost more than 15 per cent, which is a very small amount). It fails completely, and death ensues almost at once. This paper will show how a new procedure may give definite information regarding the amount of liver reserve, probable or possible liver failure, and the optimum time for operation.

THE BROMSULPHALEIN DYE TEST

In a recent communication¹ I described a new technique for the dye (bromsulphalein) liver function test. The present report has to do with further observations on, and the standardization of, this new method. The old method of doing the test was as follows. The dye was injected into the circulation and the amount remaining at a stated time interval was determined. When a 2 milligram dose was used the estimation was made at 30 minutes, and when a 5 milligram dose was used 60 minutes was considered the normal. Recently 30 minutes has been considered the time limit for the larger dose too. If more than 5 per cent of the dye remained at that time it was considered pathognomonic of liver disease. Conclusive experimental evidence has shown that this dye is excreted solely by the liver. Part of this evidence is, first, 85 to 90 per cent can be collected within

1 hour after injection, by draining the common bile duct, and, second, hepatectomy produces 100 per cent retention.

Snell and McGrath at the Mayo Clinic where this test has been used over 10,000 times, say that it is the simplest and most valuable yet devised. McGrath has shown that 96 per cent of the livers which show a retention are damaged. Bauman and Orr recently published a small series of cases from the New York Presbyterian hospital showing that 100 per cent of livers with retention had pathological processes as determined by section at operation or autopsy. Lusterman considers it to be the best test of liver function. Bourne and Rosenthal after studying the effects of different anesthetics on animals said "one result of our study was the conviction that the dye (bromsulphalein) test affords a much more definite index of injury to the liver cells than do estimations of bile pigments in the blood and urine." Relative to surgery Cantrow says that "for purposes of safety, all such individuals exhibiting any degree of dye retention should be regarded as relatively poor operative risks and, if possible, should be treated by more conservative measures until normal values are obtained." In short, it is the general consensus among authorities that it is the most practical, reliable, and valuable test for determining liver function in non-jaundiced patients. Its value in jaundice is less because the icterus of the serum changes the purple color of the dye and estimations are only approximate. Assuming that this dye test is of such value, as it is performed now, then any improvement over this method must be given serious consideration. This discussion is such a consideration.

The present method (i.e. the single determination) tells very little if the test is normal. It does not give any information about the actual length of time required for the liver to do a given amount of work, nor does it tell the efficiency with which it is done. But it is important to know this, because two livers, both of which have 0 per cent retention at the time limit, do not necessarily remove the dye in the same length of time and so cannot be the same in working capacity. One may do the work in 10 minutes and an-

¹Canadian M. Ass. J. 1933 29 556

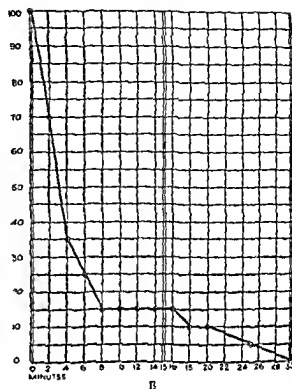
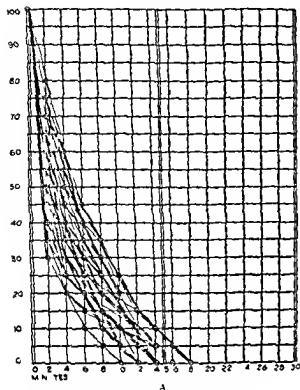


Fig. 1. This represents the curve produced by the apparently normal liver using the 2 milligram dose. It is seen that the dye is removed evenly continuously and with no hesitation. There is a constant and consistent disappearance from the blood. In this chart there are 35 normals superimposed on the same graph and the upper limits of normal are clearly defined. At 10 minutes there are only three which show over 20 per cent retention; at 12 minutes there is only one; at 15 minutes none are

over 10 per cent; and at 16 minutes none over 5 per cent. In contrast to this is the graph in Figure 1B which shows a marked difference. By the old method of determining the dye retention this result would have been considered normal because it showed no percentage retention at 30 minutes. But it is obvious that as a working unit it is much less efficient than the liver which produces a normal curve. It removes only 5 per cent of the dye in a 12 minute period. The diagnosis was carcinoma of the rectum.

other in 25 minutes yet both results would be interpreted the same. An abnormal liver with its tremendous reserve can give the same results as a normal liver if given time enough. And so it was thought that if the rate at which the liver removes dye from the blood could be determined, there might be produced a curve typical of the normal liver and that if a normal could be established then early and small amounts of liver changes could be told. This was done by estimating the remaining dye in the blood at 2 minute intervals and plotting a graph.

These graphs reveal two important facts: (1) They show that 18 minutes and not 30 minutes is required for complete removal in the normal. (2) All livers which remove 100 per cent of the dye inside the 30 minute

normal time limit do not do so by having a consistently lower reading at each successive estimation. That is the liver may not remove any dye at all for 2, 4, 6, 8, or 10 minutes and yet may remove it all within the previous normal time limit.

In comparing these curves it must be admitted that as a working unit, a liver represented by the curve showing a consistent and continuous disappearance from the blood (Fig. 1A) is more efficient than a liver which removes only 5 per cent in 12 minutes (Fig. 1B). This difference which could not be told by the single estimation is evident in the curves.

Also, it is well to consider this fact. If a liver hesitates, or has difficulty in removing a small amount of dye from the blood (Fig.

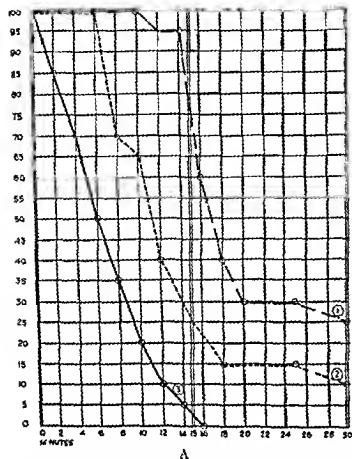
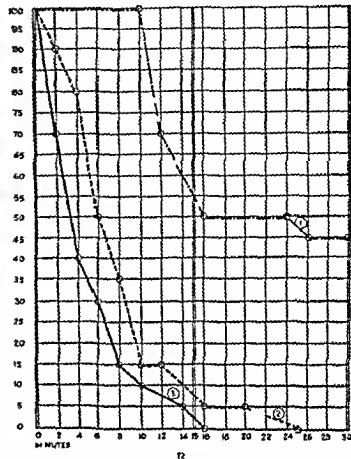


Fig 2 A shows the value this test is in pre-operative treatment. Curve 1 was made 5 days before operation for gastro-enterostomy. Curve 2 was made the day before operation and would be considered by the old method to be only slightly above normal (10 per cent retention). He received continuous 1½ per cent glucose in hypertonic saline for the intervening 4 days. (The feeding of sugar does not make any difference to the curve unless there is a definite deficiency, as there is here.) Postoperatively this man had a rough time and had he not had more good liver than there was when the first curve was made, he may not have survived. If however he had waited for operation until the liver was normal as shown by curve 3, which was done 2 weeks after operation, he may have had an uneventful recovery. This illustrates reserve and not damage. The liver's working ability was made normal by proper treatment. The first graph represents a liver all tired out, which is unable to do any extra work. Curve 3 is made of the same liver rested and fresh, ready for work. It is certainly better able to do work than the first—why



then should every person whose liver may be called on to do any extra work not be prepared and given the best liver ability possible? A liver should be given all the time necessary to get built up before subjecting it to the strain and extra burden consequent upon surgery. No one can tell when it may be needed. B Hysterectomy was performed. The second postoperative day the patient's pulse, temperature and respirations increased. There was no apparent reason for this. Her liver curve (curve 1) was bad. Had this loss of efficiency been added to an abnormal curve (Fig 2 A 1) it is easily conceivable that failure might have occurred. Hence the importance of having a normal liver. Curves 2 and 3 look alike but actually there is a big difference. Curve 2 shows a great improvement (2 days later) and curve 3 is normal (1 week later). At 4 minutes it has removed 40 per cent less dye than in curve 3, but they are both within the 30 minute time limit and by the single estimation both would be considered to be the same and normal. The curves however show this fallacy.

1, B) will it not of necessity encounter a great deal more difficulty in "looking after" the postoperative toxic products, and will it not have real trouble handling shock, trauma, and anesthesia? Indeed, is it not possible that such a liver would be unable to do this extra work and that it may fail? Such a supposition is illustrated by a man who had a partial pyloric stenosis. His liver function was bad (Fig 2 A, 1) on admission to the hospital but

it was improved by 5 days' treatment (Fig 2 A, 2). Gastro enterostomy was performed before his liver curve was normal because he refused to wait any longer. Recovery was very eventful. For 24 hours his postoperative course was normal and then he "went bad," became irrational and comatose, his pulse and temperature increased, and urine decreased with albumin 2 plus. Recovery was not assured until 3 days later, and it is suggested

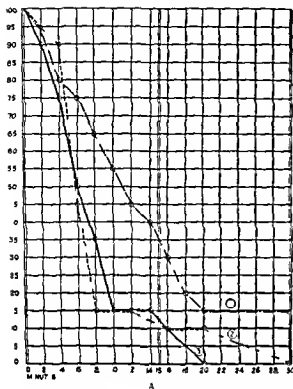
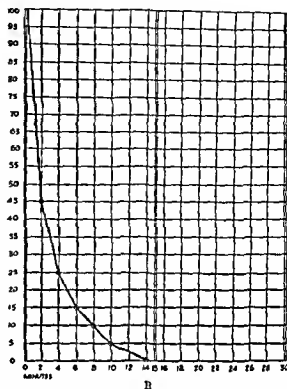


Fig. 3 A This illustrates the improvement in gall bladder disease of 12 years standing. Curve 1 was made before an acute empyema was drained and curve 2 3 weeks later. The fistula continued to drain bile and was therefore producing a gradual decompression of the liver. This had a good effect as shown by curve 3. Operative complications will be much less with a curve like 3 than they might have been had operation been done with a curve like 1. Why



then should all potential biliary tract surgical cases be not drained duodenally? B Diagnosis—chronic cholecystitis in a girl of 12 years of age. The liver shows no damage as determined by the dye retention. This is likely because the condition has been present for a short time and because all young people have such a great amount of liver reserve. This curve indicates a good operative risk. Postoperative course and subsequent health were excellent.

that if his liver had not been improved before operation recovery may not have taken place at all. No doubt the available good liver was of great help. Had operation been postponed until the curve was normal (Fig. 2A 3) it is likely that recovery would have been less disturbed. Hence the conclusion seems definite that every person should have his liver function improved before operation and if improvement cannot be made then complications should be looked for and prepared for. Such an improvement in gall bladder cases is seen in Figure 3A and the value of a normal liver, before operation in Figure 2B. If this patient had not had a good liver before operation, she might have encountered great difficulty with the loss that she suffered. Curve 1 represents the loss after operation. If she had a curve as Figure 2A 1 and the loss

after operation had been added to that instead of to a normal failure might have resulted.

Young people with cholecystitis usually have not had the disease long enough to produce liver changes and also the younger a person is the more liver power they have. This is seen in Figure 3B which is the curve of a girl 12 years of age. Operation and pathological report proved that the diagnosis of chronic cholecystitis was correct. Her recovery and subsequent course were excellent. If she had been allowed to progress for 10 or 20 years liver damage may have been marked and surgery less successful. Gall bladder pathology should be thought of more often in teen age patients. I do not think that this disease (either pathological or clinical) appears for the first time in the forties or even in the thirties. It is more often passed up —

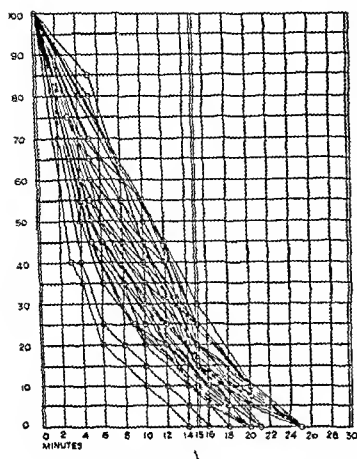
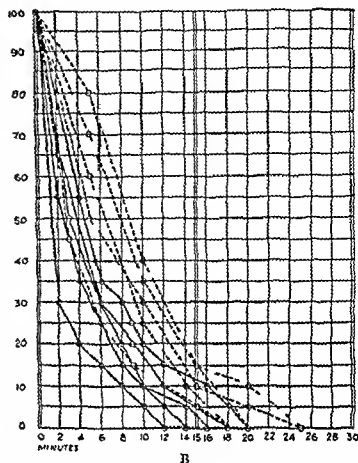


Fig 4 Twenty five normal curves picked at random. The dose was 5 milligrams per kilogram and all are out in 25 minutes with the same type of curve as was produced by the 2 milligram dose. In this case the liver has 25 times as much work to do as with the smaller dose but it does it in approximately the same length of time. This is illustrated in B where the straight line represents the milligram dose and the broken line the 5 milligram dose. These show that in some cases the larger dose is removed



and a wrong diagnosis made if one is made at all—in earlier life when a correct diagnosis could have been made if only considered. And conversely in adult life, the gall bladder is many times “sentenced” as guilty, when it is actually innocent.

LIVER FUNCTION

In structure, the liver is the least complex organ of the body. In function it is the most complex and the least understood. Its functions are many and varied and seem interchangeable one with the other. They are even able to be taken over by other units of the body in times of need, and it can carry on normal function with only 20 to 25 per cent of the parenchyma intact. Some investigators have reportedly removed as much as 95 per

cent of the liver in experimental animals before loss of function became evident. This tremendous reserve applies to its main secretion also—the bile, which can maintain normal intestinal activity with only one fifth to one tenth of its normal amount. Hence the difficulty in finding a satisfactory method of testing this organ normally or in disease.

There are only three types of cells in the liver: those lining the bile capillaries, the Kupffer cells lying along the blood channels (sinusoids), and the liver cell proper which lies between and forms the only thin partition separating these two canals.

These liver cells proper are the ones which really do all the work. Among other functions they metabolize, store, secrete, detoxify, and excrete. They are the most important

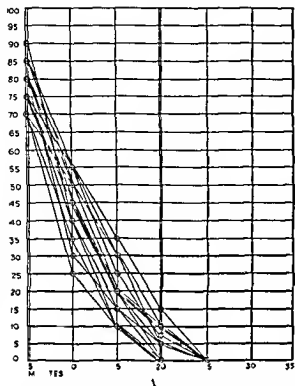
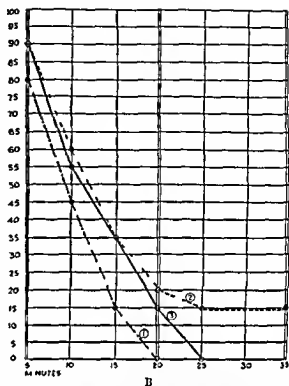


Fig 5 A represents the curves in what is considered to be a liver which functions with a maximum reserve power. The first 5 minutes of the chart have been taken off which leaves an extra 5 minutes at the end. The dye is removed consistently and it produces an even curve. This is the present normal. B illustrates how the liver loses some part of its maximum efficiency by an operation.



Curve 1 was made one day before a simple cholecystectomy was performed and curve 2 was made 24 hours later. This is not a marked removal from the normal but it is moderate in view of the easy technical work that was necessary and the short time taken. Curve 3 was made 1 week later and shows the liver back within the normal range. Diagnosis was cholelithiasis of metabolic origin.

cells in the organ as they take part in nearly every function. Because of this it seems reasonable to assume that if a dependable method can be found to tell *any* early deficiency of these cells in *any* function it would be of value—and that the earlier it could be told the better. If these cells are working below normal in any one function regardless of which function it may be—they may well become deficient in other functions also and for safety sake it should be assumed that such a deficiency will occur. Then proper precautions can be taken. *Any loss of the liver's normal ability must be considered seriously and demands careful second thought before surgery is undertaken.*

To provide a test of value a heavy burden must be put on some function which will make it work at a maximum to give the normal result. If any working unit is working with its

maximum strength using all of its reserve to give a normal result, then any loss of this reserve can more easily be seen. The repeated determinations of the dye retention depends on this theory. To find out if there is a loss of reserve is all important. When reserve in any organ—heart liver kidney, or lung—is lessened that organ has a greater chance of failing. Tests then should be tests of reserve rather than of function. The ability of the liver to work under pressure, that is after operation, is directly proportional to its reserve. Hence the imperative of knowing the relative amount of this reserve. A test, to be of value should give information regarding the amount of reserve that can be called upon in case of need before function actually starts to fail, and the amount of extra liver that can be used in an emergency, as is told by kidney reserve tests. Until all this

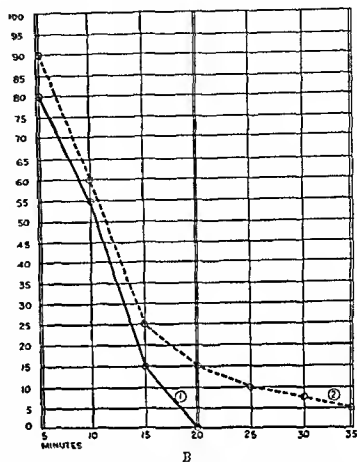
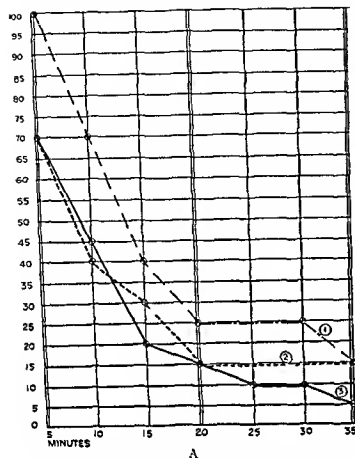


Fig 6 A is the chart of a man with a diagnosis of gastric ulcer. Because of his liver involvement, as shown by curve 1, malignancy was considered. Six weeks later, however, after a marked clinical improvement, the curve 2 was done and shows also just as marked an improvement in the liver efficiency. This illustrates very well the improvement over the old technique. In this instance both of these results would have been interpreted the same because they both had the same retention at the time limit. But it is obvious that the second is a great improvement over the first. Curve 3 was taken 3 weeks later and shows continued improvement. At the present time this would seem

to indicate the absence of malignancy because if the first curve was bad due to metastasis it likely would not have improved as readily as it did. In this particular case it is then a great value in diagnosis and prognosis. B shows the value in prognosis. The first curve was made a day before radical mastectomy was done for carcinoma. Curve 2, done 3 months later, shows the liver less efficient. If this deficiency increases it is evident that the prognosis is not as good as it would be if the curve did not become abnormal. This is an illustration of the possibilities of the improved technique.

"extra" or reserve is used up there is no loss of function. This is the reason tests of liver function give so little information. A test of function will be abnormal only after that particular function is actually failing, and this does not fail until all of the reserve is used. A liver function test will give the same result whether there be 1 or 100 per cent of reserve, and such a test is of very little help when help is needed. This reasoning made it seem probable that even the graph made by the 2 milligram dose could be improved by finding out the largest amount of dye that would give the same graph. Consequently 4, 5, 6, and 10 milligrams per kilogram of body weight were used.

It was found that the 5 milligram dose required only about 5 minutes longer to be removed than the 2 milligram dose, and that in some instances it was removed in a shorter time (Fig 4A and 4B). From this it is obvious that the 2 milligram dose does not put a maximum load on the liver. The 10 milligram dose on the other hand required 60 minutes to be completely removed from the blood and the 6 milligram dose about 35 minutes. The conclusion therefore appears definite that 5 milligrams of the dye per kilogram of body weight fulfills the requirements, namely, that it does make a liver use all of its reserve to give a normal result. The other two requirements of any such test are already

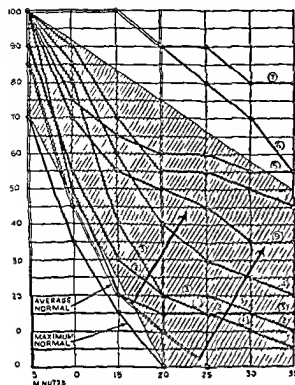


Fig. 7 This is a composite chart showing the theoretical value of this test. Curve 1 is that of a mild acute cholecystitis—first attack—32 years of age. Curve 2 is that of a young boy 21 years of age who has had two attacks of biliary colic one of which was followed by jaundice. Clinically this case should have more liver damage than the first and the curve bears it out. Curve 3 still a little further away from the normal is a man of 45 who has had three attacks of colic each one followed by jaundice. Curve 4 is that of a lady 37 years of age who has had gall bladder trouble for 30 years. Curves 3 and 4 besides showing a retention at 35 minutes have a high retention at 10 minutes. This is of great importance and if two curves both with the same retention at 35 minutes have definite retention at 10 minutes and 15 minutes the one with the higher retention has the less efficiency. This is shown very well in curves 5 and 6. Here both curves have 55 per cent at 35 minutes. By the old method these would have been considered to be the same and to be equally efficient. Curve 6 has at 15 minutes 100 per cent retention whereas Curve 5 has only 65 per cent. Curve 6 also has actual loss of function as shown by the blood bilirubin of 1.5 milligrams. Curve 5 has a maximal normal bilirubin (0.25 milligram). Curve 7 also had actual loss of function (bilirubin 3.0 milligrams). It will be noticed that as the curve moves away from the normal curve it approaches closer to the point which is inconstant where the reserve has completely disappeared and actual loss of function supervenes. That point is some place between the group of curves 1, 2, 3 and 4 and curve 7, approximately around 5 and 6. It is true then that as the curve moves toward this point it represents a liver with a diminishing reserve. Curve 5 has a maximum normal amount of bilirubin in the blood—0.25 milligram. This then represents a liver with no reserve whose function is going to start to fail almost at once.

fulfilled. They are (1) that the dye is excreted by the liver only and (2) that estimations of the remaining dye can be made with relative accuracy.

The next step in improvement was to start the graph at 5 minutes and make estimations at 5 minute intervals instead of 2 minute intervals (Fig. 5A). The longer time interval allows of more accurate color determinations, and the first 5 minutes are deleted because they show nothing this part of the graph usually being the same. It also leaves an extra 5 minutes at the end of the graph in case of disease. This curve is now considered the normal standard.

CLINICAL CASES

The clinical application of this test in the diagnosis and prognosis of cases is shown in Figure 6A. This is the chart of a man with the diagnosis of a gastric ulcer. Because of his liver involvement malignancy was thought of. The first test was done before treatment was started. After 3 weeks' treatment his clinical condition had improved very much and 6 weeks after the first curve was made a second was done. The interesting point is that at the final reading of the first two there was 15 per cent retention at both tests. But it is evident that the second curve is a great improvement over the first. This could not have been seen by the old method of determining the retention because both curves would have been interpreted in the same way as both had the same retention at the time limit. The new technique herein described shows the great advantage of the graph. The third curve 3 weeks later shows continued improvement and indicates a good prognosis and the probable absence of malignancy. If the abnormal early curve was due to secondary growths in the liver the curve would not likely improve. The change then is functional. In Figure 6B the prognosis can be determined with more accuracy than has heretofore been possible. Figure 6B was made one day before radical mastectomy was performed for carcinoma of the breast. The second curve was made 3 months later and shows definite increasing liver deficiency. This loss of liver efficiency is due either to metastasis, anemia

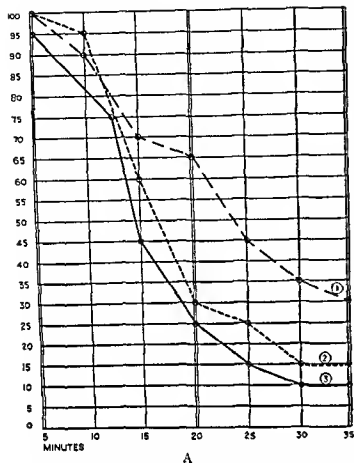
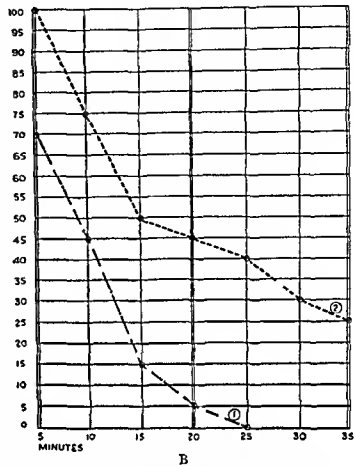


Fig 8 A is a chart with three heart conditions all of which have no increase of bilirubin in the blood or urobilin in the urine. They all represent poor operative risks and illustrate the type of case which should be improved before operation. B Curve 1 was made 1 day before mastectomy for carcinoma of the breast. The curve is perfectly normal. Curve 2 was made 24 hours later and shows a very marked loss of efficiency. This may be more



likely due to anesthetic (cyclopropane) than to the operative procedure itself. It shows too that if an operative procedure outside the abdomen can lower the liver reserve so much then intra abdominal surgery, particularly in the vicinity of the liver may of necessity lower it much more, and this may reach the point of danger especially if the normal reserve is not present before operation is carried out.

or cachexia. Whatever the reason it is apparent that the liver reserve is continually becoming less. Curves made at 3 month intervals will indicate, better than tests at present in use, whether liver reserve is decreasing or staying stationary, and by this her prognosis can be judged.

The proof that the liver loses some part of its maximum efficiency after operation is shown in Figure 5B. The first curve was made before operation for cholecystectomy. The second curve was made 24 hours after, when the maximum postoperative liver changes are present, and the third curve 1 week later, by which time it has returned to normal. This loss is not marked. The procedure was technically simple and the operation time 45 minutes. The patient was only 31 years of age and her reserve was good, as shown by a

normal curve preceding surgery, which indicates little if any liver involvement. X-ray examination showed 2 stones but because the concentrating power was good, the emptying normal, and biliary drainage showed no pathology, it was thought that the stones were metabolic in origin. This would explain the small loss of liver reserve. Apparently the better curve a person has to begin with, the less is the loss of liver reserve.

The value of the bromsulphalein curve in the estimation of liver reserve is shown in Figure 7. Here curves 1, 2, 3, and 4 all show no urobilin in the urine, and no increase of bilirubin in the blood, i.e. there is no loss of liver function as told by the present accepted early tests—but these curves show a very definite removal from the normal. Curve 7 on the other hand, shows urobilin in the urine

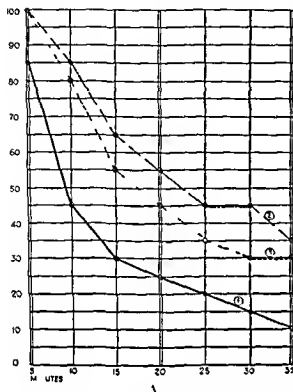
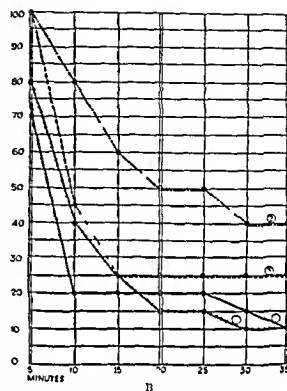


Fig. 9. A. Curve 1, 4 hours after operation for the removal of a large ovarian cyst. Curve 2, 24 hours after operation. Curve 3, 48 hours after operation. B. Female, aged 45. Curve 1, taken just before operation for cesarean section. (All pregnancies show a loss of liver reserve which is greatest in the ninth month.) Curve 2 is 22 hours after and shows the increased loss due to operation and anesthetic (ether). At this time she had a moderate upper abdominal distention, pulse 140, temperature 99.4 degrees. A diagnosis of acute gastric dilatation was made. Forty-four hours after operation the third test was done



and revealed an improved liver. Clinically she was the same and because of the improved liver function a good prognosis was given. At 72 hours (curve 4) the liver showed continued improvement. This is a graphic illustration showing how the liver can and does change its working ability through a wide range before any loss of function is produced. In other words it shows how much extra work the liver can do in case of emergency. This has been a clinically accepted fact for some time but it has never before been shown graphically.

and an increase of bilirubin in the blood. This is associated with an actual loss of liver function and it is seen therefore that the further a curve moves away from the normal standard the more the reserve decreases. This decrease of reserve will continue until loss of function actually begins and the relative amount of reserve left before function will start to fail can be told from the graph. At some inconstant point between the lower group and curve 7, reserve is completely used up and loss of function begins. This point is approximately at where curves 5 and 6 end.

Curves 5 and 6 are of great interest. Both have 55 per cent retention at the 35 minute mark, but the former has a loss of function as shown by a bilirubin of 1.5 milligrams and the

latter has no loss of function as shown by the blood bilirubin of 0.25 milligram, which is the maximum normal. Although the last part of the curves are the same, and the previous interpretation would indicate that they had the same working ability, the first parts are very different. This early part is of importance in evaluating liver reserve. At 15 minutes the upper curve 6 still had 100 per cent retention and the lower 5, 65 per cent. Retention in this first part of the curve is of more importance than in the latter part, and indicates more loss of reserve than it does in the last part.

Function tests will show nothing abnormal until that function fails, but the improved technique will show liver changes before the

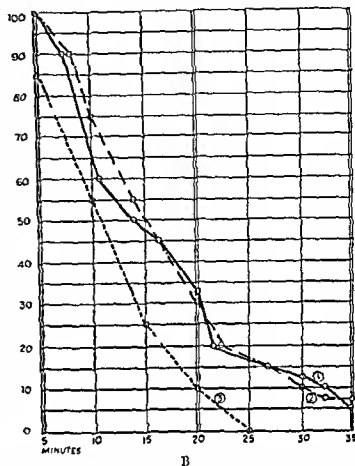
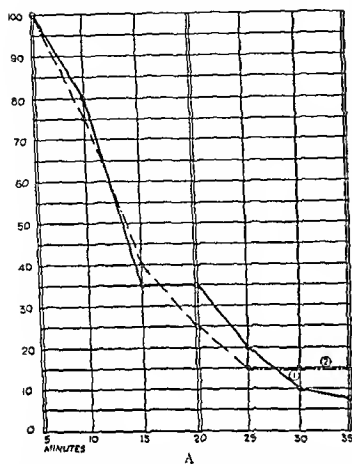


Fig 10 This shows that the liver does not lose its maximum efficiency directly after operation A - is 1 hour after a strangulated hernia was repaired. The patient a man 79 years of age had a spinal anesthetic. The curve before operation was abnormal which would be expected in a man of his age. B (1 and 2) are graphs made 1 hour before and 1 hour after operation for a twisted ovarian cyst. The patient was a girl 27 years of age and was suf-

fering from a moderate degree of shock. She had a spinal anesthetic. In this case also the pre operative liver efficiency was decreased as shown by the curve and this is doubtless due to the presence of shock. Three weeks later the curve was normal. Compared with Figure 9 it appears that the loss is maximum between 18 and 36 hours. This is the time at which liver deaths occur! What is the relationship?

accepted tests of function are abnormal. By this you can estimate rather accurately how much reserve there is in store before function will fail. This estimation is of the utmost importance in surgical cases. Also, it is readily seen how this reserve increases and decreases, hence its value in diagnosis and prognosis, because the prognosis cannot be good in the presence of a curve moving away from the normal, nor can treatment be considered successful under the same circumstances. Differences in rate indicate differences in efficiency, and if changes in liver efficiency, for either the better or the worse, can be told, the prognosis can be judged so much better.

TECHNIQUE

The technique is simple. One venipuncture is sufficient for taking all the blood samples

The needle (short bevel and 18 or 20 gauge) is inserted as for a Wassermann. It is left in the vein and a Luer 3 way spinal monometer valve is connected to it, on one arm of which is a tube leading from a jar of saline (Fig 11, 1). With practice it is more convenient to insert the needle and valve together as shown in the illustration. With the handle in the position shown it is just as easy to tell where the needle is in the vein, as it is when the needle is joined directly to the syringe. The Baxter intravenous jar is used because it is so convenient for office use. Five hundred cubic centimeters will last for at least three patients. When the fluid, controlled by clamp, 3, is running satisfactorily as told by the vacuum drip, 2, the measured dose (5 milligrams per kilogram body weight) is injected slowly in any other vein so that the dye will

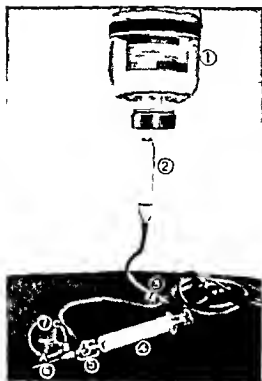


Fig. 11

not contaminate the withdrawals which it would do if injected through the needle in the vein. The saline is used only to keep the blood way clear and to prevent clotting by stagnation between the withdrawals. The small handle on the valve can be turned in three directions directing the flow through the needle end into the vein (7 A) or open end to wash out any small clot (7 C) or allowing of direct suction from the vein (7 B or 5). For withdrawing the samples the handle is as shown in the ensemble 4, 5, and 6 and between times it is as seen in 7. In this position the fluid runs slowly through the needle keeping it clear. The blood is withdrawn every 5 minutes and put in a clean test tube. Although the same syringe can be used for all the samples it is better to have 7 clean ones. It is allowed to stand for 10 to 15 minutes after the final estimation and centrifuged. The clear supernatant serum contains the dye and each sample is examined the amount remaining is determined and the graph is plotted.

The estimations are done by comparison with a set of color standards¹ after the serum has been alkalinized to bring out the color of the dye.

SUMMARY

This work is not complete. It has all been done on private patients which presents certain difficulties some of which can be overcome and some can not. Chief of the latter class is the lack of material and follow up which is necessary to prove certain suppositions. The other and equally important factor is time.

Over 100 tests have been done. Because it seems to be a definite improvement over any tests of liver efficiency now in use the results would seem to be worthy of further clinical evaluation. The possibilities of its value are great.

CONCLUSIONS

This work must of course, await confirmation. However if these results are proved to be correct then we can conclude that:

1. We have at our disposal a practical and clinically valuable means of determining liver reserve.

2. This estimation will be of definite value in attempting to lower the mortality in surgical cases—especially gall bladder surgery—by picking the optimum time for operation.

3. It will be of great value in the prognosis of all surgical cases.

4. The liver is affected in every disease and by every operative procedure.

5. A liver can have its functioning ability or reserve improved if time and the proper measures are taken.

6. Its value in medical cases may be almost as great.

Acknowledgment is made to Drs. W. J. Macdonald, L. H. Wenden and V. D. Konkin for the privilege of using illustrative cases.

The work was made possible through the courtesy of Hynson, Westcott and Dunning who supplied the dye for the study.

NOTE.—Since this paper was submitted for publication final tests have been performed on the patients illustrated in Figures 6A, 9, 10. They are all normal.

FIGURE 11. The apparatus used in the estimation which consists of a container (1) with a handle, a tube (2) leading from the container down to a syringe-like device (3). The syringe has a plunger and a needle. The needle is inserted into a vein (4). The syringe is connected to a small pump or valve mechanism (5) which is also connected to a larger container (6). The entire setup is used for drawing blood samples from a vein.

PROCTOGRAPHY

Roentgenologic Studies of the Rectum and Sigmoid

ALBERT OPPENHEIMER, M D, and GEORGE W SALEEBY, M D, Beirut, Lebanon, Syria

THE roentgenologic examination of rectum and sigmoid is not infrequently interfered with by a number of technical difficulties. First, by reflux of the opaque enema, ilcal loops may fill and overshadow the sigmoid and upper rectum, second, too massive a filling before evacuation, or an insufficient one after it, may render the mucosal relief invisible or visible only in part, finally, during the inflow of the opaque medium, the junction of sigmoid and descending colon may form an acute angle which, acting like a valve in interrupting the flow, may cause in the sigmoid such dilatation and elongation as may simulate pathological enlargement (Fig 1). Although this distention is usually avoided by giving the enema with the patient prone and under continuous rotation, there are instances in which it becomes very difficult to distinguish between true and artificial enlargement, especially in elderly people in whom the elasticity of the intestinal walls is diminished.

Because of its long mesentery and owing to certain phases of physiological activity, the sigmoid normally varies considerably in size and position in the selfsame person. When by mass peristalsis the contents of the transverse colon are driven into the descending portion, the sigmoid fills simultaneously in case the contents are fairly liquid or mass

movements very effective, in other instances, when the amount passed on into the descending portion is less, or when the descending colon is especially long, the sigmoid fills after an interval by what appears to be the peristalsis of the descending portion. While being thus filled, the sigmoid relaxes, as previously reported (12), and this physiological enlargement causes the sigmoidal loop to form a wide circle which may reach upward to the epigastrium, and to the right as far as to the cecum (Fig 2). Then, either immediately, or up to 3 hours before defecation, the sigmoid is evacuated by one or several tonic contractions, whereby it may form, after contraction, a secant of the circle it formed before (12).

The difference in length before and after this movement may be considerable, in one case, the sigmoidal loop was 61 centimeters long before, and 19 centimeters long after contraction, as measured on the films. The barium that is passed on into the rectum distends the latter, whereupon evacuation may occur almost immediately by peristalsis of the rectum. In other cases, there is an interval of from 10 minutes to several hours between the emptying of the sigmoid and that of the rectum. This interval is much increased in dyschesia and in certain anatomical lesions of the distal colon.

From the physiological enlargement just referred to, true anatomical redundancy and

From the Department of Roentgenology, American University of Beirut

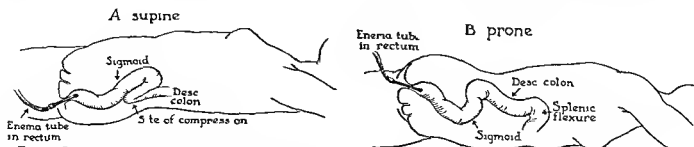


Fig 1. In the supine position A the sigmoid loop slides backward thus pressing upon the descending colon and obstructing the flow of the opaque enema whereby the

sigmoid may become distended. This is avoided when the patient is placed in the prone position B.

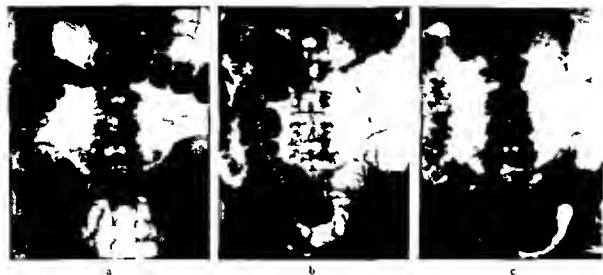


Fig. 2 Physiological enlargement of sigmoid colon 2.5 hours after opaque meal. b 20 minutes later opaque material has driven the opaque content of the

transverse colon into the descending portion and c 2 hours later the sigmoid has again become markedly contracted.

megacolon differ by their persistence after evacuation. But even what appears to be a persistent enlargement may in reality be the result of functional disorder. For instance during renal or biliary colic there may be acute atony of the colon or sigmoid which may cause such enlargement as to simulate

true megacolon (11). In other cases the cause of this atony is not known. In a woman 49 years old who complained of vague discomfort a shallow ulcer at the posterior wall of the duodenal cap was associated with extreme dilatation and elongation of the entire colon including the sigmoid but a

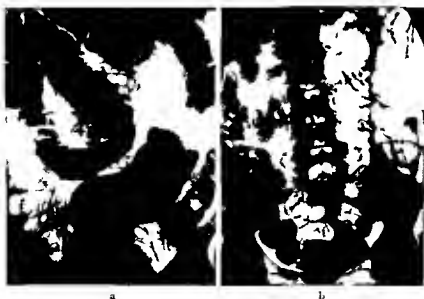


Fig. 3 Pathological atony. a colon after spontaneous evacuation of an opaque enema. Note the extreme dilatation and elongation. b 25 weeks later the colon has regained normal proportions. See text.



Fig 4 Roentgenograms in 2 cases of adhesions between sigmoid and cecum which were due to chronic ap



pendicitis Operative and histological confirmation of the condition was made

few days later, as well as on three examinations made at intervals during the subsequent 18 months, this enlargement was not seen again (Fig 3). A similar "pseudo megacolon" was found by Bernstein in a child during a

severe general infection. These observations are concordant with the results of experiments in man (11) and animals (1, 2), which show that paralysis of the colon may be induced by extra intestinal lesions, they support Alvarez'



Fig 3 Pseudo adhesion—the angulation and displacement of the sigmoid (arrows) are accidental as evinced by



re examination by roentgenogram at right, after 4 days. No adhesions were found on operation.



Fig. 6 Sigmoid (arrows) prolapsed into inguinal hernia x

view that in these cases atony is due to inhibitory reflexes as the intestinal muscle is not damaged (2). The occurrence of intestinal paralysis in renal colic was known to the older clinicians (10).

Displacement of the sigmoid occurs in the presence of adhesions and tumors in the lower abdomen and in inflammation of the pelvic organs in the latter condition deformities and angulations frequently coexist. Displace-

ment to the right results chiefly from perityphlitic adhesions (13), for, owing to the fact that the sigmoid is relaxed for the greater part of the day, it is frequently in contact with the cecum where it may become adherent when the latter is inflamed (Fig. 4). The top of the sigmoidal loop then may become angulated during contraction at the site of adhesion. Such angulation however may be merely temporary and accidental as illustrated in Figure 5. Hence it is necessary to verify that displacement and deformity are persistent.

Shortening, narrowing and rigidity of sigmoid and rectum occur in inflammatory, fibrous and malignant involvement. Parts of the sigmoid may be found prolapsed into an inguinal hernia (Fig. 6).

As above mentioned, examination of the mucosal relief of rectum and sigmoid is often interfered with by the inconstancy of the filling. Since the interpretation of the mucosal pattern depends entirely and almost exclusively upon a controlled standard coating an attempt was made to provide for constant filling by the following method. The patient is in the prone position, a flexible urethral catheter is introduced into the rectum until the tip of the catheter meets with resistance

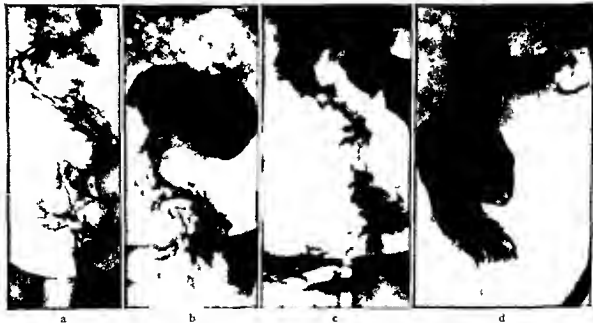


Fig. 7 Various types of normal mucosal pattern in rectum and lower sigmoid

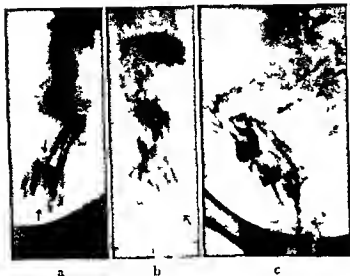


Fig 8 a b Two cases of hepatic cirrhosis with internal hemorrhoids seen in longitudinal a and axial projection

By means of a syringe, about 2 cubic centimeters of barium suspension¹ are instilled in

¹Any type of barium may be used. We have used the standard mixture given in examinations of the stomach.



b c villous proctitis (histological confirmation) d and e prolapse of rectum around internal sphincter (see text)

order to show the lumen of the catheter on radioscopy. Injection then goes on under radioscopic control until the sigmoid is sufficiently filled, whereupon the catheter is



Fig 9 Dyschezia. Colon 8 hours after barium meal rectum overfilled; colon almost empty. Barium was retained in the rectum during the subsequent 4 days. Insert: enlargement of internal sphincter (arrow) in the same patient possibly due to spastic contraction or actual hypertrophy. Compare with normal sphincter (Fig 7 a 7 d).



Fig 10 Volvulus of sigmoid (operative confirmation). Sigmoid loop distended with gas. Mucosal relief of rectum appears as though cut off.



Fig. 11. Tumors not distinctly visible on plain proctography but revealed after insufflation of about 15 cubic centimeters of air. a, b, c, Small cancer circular of upper rectum (operative and histological confirmation) not visible before air insufflation. a, but revealed after it. b, c, d, e, ulcerating hard tumor within anal canal not dis-

covered on numerous proctoscopic and x-ray examinations because both proctoscope and enema tube slipped by the malignancy which led to the tumor. d, before e, after air insufflation.

gently and gradually withdrawn while injection still continues. As a rule from 10 to 30 cubic centimeters are necessary to produce the filling desired. If the amount injected seems too large, some opaque fluid is aspirated. After spontaneous evacuation the entire mucosal relief is uniformly coated. Air insufflation may follow if necessary (Fig. 11).

This method has the following advantages:

(1) in the presence of stenosis or inflammation

of the rectum the catheter passes without causing pain, spasms or such alteration as might change the appearance of the mucosa. (2) the filling is controlled, (3) there is no overshadowing by other loops, (4) no distention is produced that might simulate



Fig. 12. Thrombosed hemorrhoidal vein.



Fig. 13. Intussusception of sigmoid (arrows). Note the overriding of the rugae. Operative confirmation.



Fig 14 Cancer of rectum Opaque enema does not reveal the tumor the enema tube passes beyond it, b and after spontaneous evacuation there is no distinct filling

defect a Proctography shows tumor (arrows) and its central crater r f Specimen from operative removal Note similarity of roentgenological and anatomical appearance

redundancy or obstruction The sole disadvantage of the method lies in the fact that it demonstrates the distal part of the colon only, for completion of the examination, an opaque enema has to be given later by connecting the catheter with an enema device

Roentgenograms are taken in the oblique position, the patient, supine, being rotated to his left side so that his right iliac crest is raised by about 45 degrees from the Potter-Bucky grid In this position, the entire length of the sigmoid is shown, and the roentgeno-



Fig. 11. Tumor is distinctly visible on plain proctography but revealed after insufflation of about 15 cubic centimeters of air. a b c Small cancer circular of upper rectum (operative and histological confirmation) not visible before air insufflation a but revealed after it b c d e ulcerating hard tumor within anal canal not discovered on numerous proctoscopic and x-ray examination because of lith proctoscope and enemata tube tipped by the small mass which led to the tumor d before e after air insufflation

gently and gradually withdrawn while injection still continues. As a rule from 10 to 30 cubic centimeters are necessary to produce the filling desired. If the amount injected seems too large some opaque fluid is aspirated. After spontaneous evacuation the entire mucosal relief is uniformly coated. Air insufflation may follow if necessary (Fig. 11).

This method has the following advantages (1) in the presence of stenosis or inflammation

of the rectum the catheter passes without causing pain spasms or such alteration as might change the appearance of the mucosa (2) the filling is controlled (3) there is no overshadowing by other loops (4) no distention is produced that might simulate



Fig. 12. Thrombosed hemorrhoidal vein



Fig. 13. Intussusception of sigmoid (arrow). Note the "overriding" of the rugae. Operative confirmation

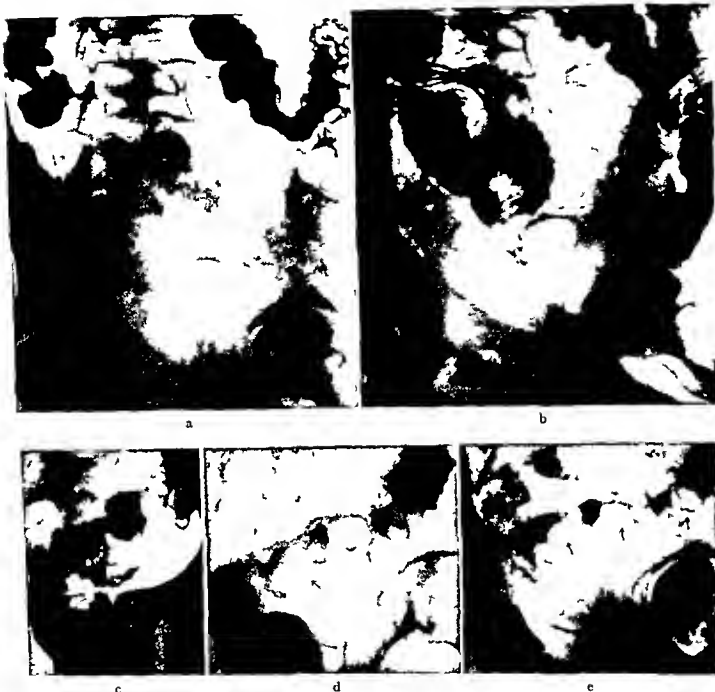


Fig 16 Cancer of sigmoid (operative and histological confirmation) a b opaque enema With slight filling a the tumor is not distinctly visible with more massive

filling b reflux into ileum overshadows the diseased region c d e Proctography in sagittal projection c and in oblique views d e with variable amounts of filling

part of the rectum protrudes in a circular pouch above the anus (Fig 8, d) Possibly this is a condition which precedes the formation of actual prolapse

In typical dyschezia, that is, retention confined to the rectum and associated with normal or accelerated passage through colon, the internal anal sphincter has been found enlarged, as shown by increased impression it produced upon the rectal lumen (Fig 9)

Internal hemorrhoids are not always visible, even in the presence of demonstrable esophageal varices (hepatic cirrhosis) Hemorrhoids cause either rounded defects about 4 to 6 millimeters in diameter, when seen in optical sections, or increased distance between the mucosal furrows, when projected longitudinally (Fig 8, a) In one case of hemorrhoidal thrombosis, the hardened vessel was seen as a tubular defect (Fig 12)

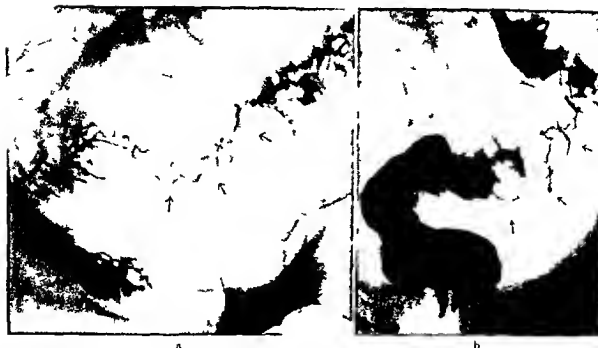


Fig. 1. Diapnoic error. Both in oblique a and in frontal projection b the lower sigmoid is narrowed in

lumen and there are persistent filling defects in its mucosal relief (arrows). Operation: no tumor, moderate congestion.

Intussusception of the sigmoid has been observed in but one instance; the overriding of the walls is characteristic (Fig. 13).

Volvulus of the sigmoid causes a pathognomonic appearance at the junction of rectum and sigmoid: the mucosal relief ends abruptly in an oblique line as though cut through with a razor blade. The distended sigmoid marked by its gaseous filling is seen a few inches above this line; obviously the latter corresponds to the caudad border of the twist (Fig. 10).

Polyps and other tumors are very accurately shown with the technique here described. For example, in a case of a confirmed carcinoma of the rectum in a young woman the normal enema tube passed beyond the tumor wherefore the latter escaped visualization (Fig. 14 b). But in injecting barium through the catheter the tumor and its central crater were by reflux surrounded with barium which produced a filling defect visible even before withdrawal of the catheter (Fig. 14 c). In another case a persistent irregularity of the mucosa of the sigmoid associated with narrowing of its lumen (Fig. 17) was diag-

nosed as an infiltrating tumor, but on operation the region suspected showed merely congestion. The patient, a man 60 years old, had complained of frequent profuse bleeding from the rectum; the cause of which was not elucidated by further clinical and laboratory examinations.

In cases of lymphogranuloma inguinale (or venereum) as verified by positive Treves tests the rectum was narrowed, rigid, devoid of mucosal pattern and pipe shaped.

Fistulas, diverticula, sinuses and the like are easily revealed by any method. Syphilis of the rectum was observed in one patient in whom it produced the x-ray appearances of an infiltrating growth.

In one case of villous proctitis confirmed by biopsy the rugae were enlarged and interspersed with polypoid excrescences (Fig. 8 c). In other cases of proctitis no positive findings were found as the alterations in the mucosal pattern did not exceed those noted as normal variations.

CONCLUSIONS

By a simple modification of the opaque enema method roentgen examination of sig-

moid and rectum can be freed of the technical hazards which often impede consistent results. By the procedure here described, the amount of opaque filling in rectum and sigmoid is technically controlled. Both in its advantages and in its limitations, this method resembles the examination of the gastric mucosa while tumors and similar lesions are demonstrable with a comparatively high degree of accuracy, inflammation often escapes recognition, as individual and physiological modifications of the mucosal pattern are normally more numerous and diverse than the pathological alterations observed, or theoretically expected, in inflammation.

As in the stomach, variations of tone may simulate anatomical alterations. For instance, atony of the sigmoid is physiological during the period at which the sigmoid fills from above, this relaxation frequently amounts to such enlargement as encountered in redundancy and megacolon. A more persistent though also transient form of atony may occur in renal colic and other abdominal diseases as a result of reflex disturbances, and may be produced experimentally by distention of the renal pelvis (11). In statistical investigations on "anomalies" of the colon, these physiological and pathological states of transient atony have hitherto not been taken into account.

SUMMARY

1. A simple technique, proctography, is described by which in roentgen examinations of rectum and sigmoid the opaque filling is technically controlled.

2. With this method, the normal and pathological appearances of rectum and sigmoid, especially of their mucosa, are demonstrable with a degree of accuracy similar to

that now attained in roentgen examinations of stomach and duodenum.

3. The mucosal pattern varies normally so much as to render it difficult to recognize typical signs of inflammation, unless there are secondary changes such as fibrosis or well marked mucosal hypertrophy or atrophy.

4. By loss of tone, the sigmoid loop may be greatly enlarged, especially during the physiological relaxation which occurs while the sigmoid fills from above. Besides this normal enlargement, pathological atony, as in renal colic and certain abdominal diseases, may simulate redundancy, megacolon, or obstructive dilatation.

REFERENCES

1. ALVAREZ, W. C. *The Mechanics of the Digestive Tract*. New York 1928.
2. ALVAREZ, W. C. and HOSOI, K. What has happened to the unobstructed bowel that fails to transport fluid and gas? *Am J Surg*, 1929, 6: 569-578.
3. BARCLAY, A. G. *The Digestive Tract*, 2d ed. Cambridge 1936.
4. BÉZI, Quoted by Bernstein loc cit.
5. BERNSTEIN, B. M. A case of infectious ileus or pseudo megacolon (Hirschsprung). *Am J Roentgenol* 1927, 18: 53-54.
6. CASE, J. T. Fundamentals in roentgenology of the colon. *Am J Surg* 1930, 8: 844-858.
7. ELZAS, Quoted by Bernstein loc cit.
8. KANTOR, J. L. Anomalies of the colon: their roentgen diagnosis and clinical significance. *Radiology* 1934, 23: 651-662.
9. LARIMORE, J. W. Roentgenology of the colon: its value in clinical medicine. *Am J Roentgenol* 1928, 20: 101-113.
10. NATHAGEL, H. *Diseases of the Intestines and Peritoneum*. Philadelphia 1904.
11. OPFFNHEIMER, A. Acute transient intestinal atony. Fifth Internat Congr Radiol. Chicago 1937.
12. Idem. Physiologie der Dickdarmmotorik. *Klin Wchnschr* 1931, 10: 201-204.
13. Idem. Die Roentgenzeichen der sogenannten chronischen Appendicitis. *Wchnschr* a. d. Geb. d. Roentgenstrahlen 1931, 44: 600-615.
14. SHANKS, S. C. *Alimentary tract*. In: *A Textbook of X-Ray Diagnosis by British Authors*. Edited by S. C. Shanks, P. Kerly and I. W. Twining. London 1938, vol. 2.



Fig 1 Showing the method of hand retract n The gall bladder has been removed



Fig 2 Opening the duct Note position of ucker and of guy sutures Inset 'oun is being passed into the duct

CLINICAL SURGERY

FROM ST VINCENT'S HOSPITAL, SYDNEY

CHOLEDOCHOLITHOTOMY

MacCormick's Technique

DOUGLAS MILLER, F.R.C.S., Sydney, Australia

THE following is a description of the technique employed by Sir Alexander MacCormick, of Sydney, and used by a large number of Australian surgeons whom he trained

DANGERS AND POSSIBLE COMPLICATIONS

Choledocholithotomy is very frequently performed upon the jaundiced patient, who may therefore be an exceedingly poor operative risk, because of the dangers associated with jaundice and liver failure

After choledocholithotomy we are faced with the possibility of acute bile duct infection, of bile peritonitis, or of a biliary fistula, the latter resulting from neglect to remove all calculi from the duct. This mistake may not lead to fistula formation unless duct obstruction occurs but it may lead to that most distressing and humiliating complication, recurrent attacks of pain and jaundice, in no way different from those the operation was designed to cure

Jaundice undoubtedly constitutes an added operative risk, because of the liability of the patient to hemorrhage. If there is evidence of the jaundice subsiding or if previous similar attacks suggest that it is likely to subside, I wait for this to occur. However, if there is no sign of the jaundice subsiding, I consider it best to operate with all due precautions, rather than expose the patient to the added risks of prolonged common duct obstruction

PREPARATION

The general preparation followed is for the patient to be admitted at least 48 hours before operation. A routine aperient is given 24 hours before, and an enema 12 hours before operation. Fluids are encouraged until 4 hours before operation. When jaundice exists the patient is observed

for a longer period, the blood coagulation time is estimated and, if prolonged, 10 cubic centimeters of 5 per cent calcium chloride is given intravenously on two consecutive days. If the coagulation time is not thus brought back to normal, a small transfusion of 200 cubic centimeters of citrated blood is given and as a rule this will be successful

When the patient has been jaundiced for a long time, bile salts administered by mouth for some days and glucose in a readily assimilable form should be freely given. If the patient's condition is grave, 600 cubic centimeters of 5 per cent glucose in saline should be given intravenously on the day before and the day of operation

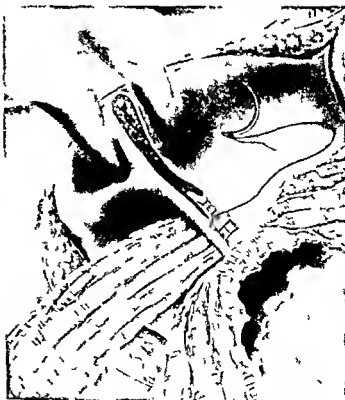


Fig. 3 Closure of the duct and the gastrohepatic omentum

Drawings for Figures 1 and 3 are reproduced through courtesy of *Australian and New Zealand Journal of Surgery*

TABLE—LENGTH OF STAY IN HOSPITAL

C mbe	Ind at f pe g d t	Ope an	Removal f t (le-d)	Disch rged after perat n—day
	Ja i e	Remo l f t n d d t at	4	4
	H t ry f j i e	D i t t	6	30
3	Ja i c	R mo al f i n e a l l at i n	4	22
4	H t ry f j a d e	R mo al f i a n d d t t	5	25
5	Ja d	R mo l n d d t at	4	20
6	J i e	Remo l a n d d t at	3	6
	H t ry f j i	D i t t n	3	
8	H t ry f j d	D i t at n	1	0
9	H t ry f j d	R em o a l d d t at	3	35
	H t f j d e	D i t u n	3	20
	H t ry f j d e	R mo l a d d t at		9
	J i e	R mo l d d t t i n	3	17
3	H t ry f j d	D i t at		
4	J n d	R mo al n d d t i n		10
5	H t ry f j i	D i t t	0	
6	H t y f j d e	R mo al f d d t i n		4
	H t f j d e	D i t t	5	1
8	J d e	R mo l n d d t t u o	3	4
9	J u l e	R m l d d t i n	3	9
	J i	R m l n d d t i n	3	

ANESTHETIC

Open ether is the usual anesthetic though of late cyclopropane reinforced by same basal anesthetic has been much used

TECHNICAL STEPS IN OPERATION

Position A small sand bag or bridge is placed across the back at the level of the angle of the scapula

Incision We are guided by the physical character of the patient. In a patient with a narrow subcostal angle the right paramedian incision with lateral displacement of the rectus is the most generally useful

In the more common type with a broad subcostal angle we have come to favor a transverse incision with division of the rectus or an obliquely placed incision extending from the xiphoid region down and outward with partial longitudinal splitting and partial transverse division of the rectus. Prior to dividing the rectus muscle I pass a double row of single catgut sutures through the anterior sheath and the muscle in order to control bleeding. The muscle is then divided between these rows

After division of the rectus in either of the two latter incisions the posterior rectus sheath includ

ing the transversus abdominis muscle is divided in the same direction

On opening the peritoneal cavity I make a preliminary exploration and palpate the gall bladder bile ducts pancreas stomach and duodenum. Three packs are then inserted one displaces the stomach to the left one displaces the transverse colon downward and the third is placed in the right extremity of Morrison's pouch

It is the usual practice in these operations to do a routine cholecystectomy first but if the patient's condition is grave the urgent necessity is to clear the common duct and the cholecystectomy may be postponed either until the end of the operation or a subsequent date. If cholecystectomy is performed we do not try exploration of the common duct through the open stump of the cystic duct as this is usually most unsatisfactory and a waste of time

The packs already placed are carefully arranged to shut out the peritoneal cavity and the left hand of the assistant is inserted over them with fingers extended exerting a slight traction on the lesser omentum in a caudal and forward direction. No mechanical retractors are used. An excellent view of the right free border of the gastrohepatic omentum is now obtained. A long strip of gauze

is picked down into the foramen of Winslow, and fills the space to the right of the foramen. The nozzle of a sucker is held close to the duct in the right hand of the second assistant. The peritoneum over the duct is incised longitudinally, and two "guy sutures" of fine silk are inserted on each side of the duct at some point convenient for incision.

With a fine pointed scalpel, the duct is now opened by an incision 1.5 centimeters long in the line of the duct. The bile which escapes is evacuated in the sucker. The identification and opening of the duct may present some difficulty in cases in which there has been much inflammatory thickening or adhesion formation. Needless to say such difficulties call for punctilious care in identification of the duct before any incision is made. An exploratory puncture with a fine needle will readily clear up any confusion between bile duct and portal vein. When the duct is open stones may be removed with a malleable scoop or Desjardin forceps. This is not always a simple matter and frequently a stone will need to be gently dislodged and milked up to the opening by the surgeon's fingers, manipulating the duct from its anterior and posterior aspects in the foramen of Winslow.

Stones impacted in the lower end of the duct may present extreme difficulty particularly as they are frequently so difficult to feel. When the surgeon has dislodged all obvious calculi, a fine probe or sound is inserted into the duct and gently guided until it finds its way into the duodenum. This is followed up by a slightly bigger Lister sound and this in turn by others gradually increasing up to about 10 to 13. As each sound reaches the sphincter of Oddi, it pauses momentarily and then with a slight jerk slips into the duodenum. The sensation is similar in a very delicate way to the sensation of a uterine dilator slipping through the cervix. During this maneuver it is no uncommon experience to find that on increasing the size of the sound, an obstruction is encountered, though the previous ones slipped most readily into the duodenum. This obstruction is always a stone, and fresh effort must be directed to its removal. It is common to find that once again a slightly larger sound will meet with another obstructing stone. Such experiences as

this shed light on those cases in which jaundice follows on operations in which the surgeon has been content merely to establish the patency of the duct with a probe.

When the ampulla of the duct has been sufficiently dilated, a scoop should be pressed up to explore the hepatic duct. The common bile duct is then sutured with fine interrupted catgut and the split peritoneum sutured over it with a continuous catgut suture, which is carried up to peritonealize the gall bladder bed when cholecystectomy has been performed. A large tube at least 15 centimeters in diameter is inserted through a stab incision low in the loin, and placed with its end lying just to the right of the common bile duct. A narrow ribbon wick threaded through the tube will serve to anchor it in position. The packs having been removed, the abdomen is closed. We suture each aponeurotic layer with interrupted mattress sutures of chromic gut. Interrupted silkworm gut and continuous catgut close the skin. A separate dressing soaks the main wound from the stab wound. Gauze is then packed around the projecting end of the tube so that drainage fluid will be absorbed.

POSTOPERATIVE CARE

The tube usually drains a little bile for 2 or 3 days, but sometimes the closure of the duct is so satisfactory that no drainage occurs. The wick is withdrawn at the end of 24 hours, and the tube is withdrawn when drainage has ceased. During the first 24 hours the patient is best nursed in a semirecumbent position with a slight tilt to the right.

A long experience with this technique has proved its great value. Adequate common duct drainage is established into the duodenum. Patients rapidly lose their jaundice, and it is most unusual for external drainage to last longer than a few days.

The average convalescence is little if any longer than that of cholecystectomy, and postoperative troubles are minimized.

In a series of 20 consecutive cases in which patients were treated in this way at St. Vincent's Hospital there was no mortality and the length of stay in hospital in each case is shown in the accompanying table.

AN OPERATION FOR THE REPAIR OF DIRECT INGUINAL HERNIA

J DEWIA BISGARD M.D. Omaha, Nebraska

A BRIEF resume of the problems associated with the repair of direct inguinal hernias was reported in a previous publication. It is the purpose of this communication to describe an operative technique, an essential part of which was devised by Dr. C. W. M. Poynter, dean of the University of Nebraska School of Medicine, and used by him in 1905 in the treatment of one case. This case twice recurred following previous repairs; has remained cured. Because Dr. Poynter subsequently diverted his talents to an academic career, the operation was given no further trial until its recent application in 6 cases by the author. The operation appears to have such obvious merits that it is reported without recommendation from a large and extended clinical trial. It utilizes a flap of the pectineus portion of the pelvic fascia and the pectineus muscle and muscle to obliterate the defect in the floor of the inguinal canal. This flap is sutured to the transversalis fascia and to the deep surface of the internal oblique aponeurosis so

that in reality a small segment of the pelvic wall is shifted mesialward where it forms a deep or first line of defense. This support is supplemented by obliteration or reinforcement of the inguinal canal by one of two methods in both of which living sutures of fascia are used.

TECHNIQUE

Omitting a description of the routine details of exposure of the inguinal canal, elevation of the cord from the canal, and the inversion or excision of the sac, the transversalis fascia and peritoneum are separated from loose attachments below Poupart's ligament and retracted mesialward, exposing those portions of the pelvic fascia and of the pectineus muscle and fascia which cover the superior ramus of the pubis. This exposure extends from the pubic spine to the superior border of the femoral canal. The femoral vessels are retracted superiorly and laterally. Gimbernat's ligament is incised to expose the pectineus fascia down to the pubic spine. This fascia and the

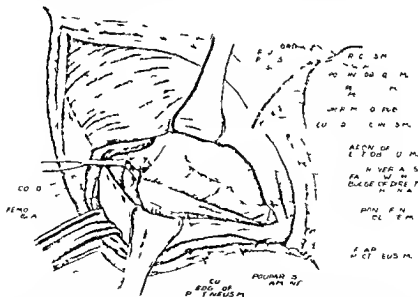


Fig. 1. A pedicled flap of pectineus muscle and fascia and pelvic fascia has been raised from the superior ramus of the pubis and the first and lowermost stitch approximating it to the aponeurosis of the internal oblique has been placed. The inset illustrates the repair as seen in cross section.

underlying muscle fibers are then incised along the anterolateral margin of the pubic ramus from the pubic spine to the upper limit of the exposure. A pedicled flap, including both fascia and muscle, is raised from the anterior and mesial surfaces of the ramus, and this flap is of sufficient length to reach the deep surface of the internal oblique aponeurosis and conjoined tendon without tension. The flap retains its normal deep attachment throughout its breadth so that suture of its free margin to the mesial border of the inguinal triangle forms under this triangle a strong supportive wall which is continuous with the pelvic living membranes. The free margin is approximated with interrupted sutures of silk or chromic catgut to the deep surface of the free border of the conjoined tendon, internal oblique aponeurosis, or rectus sheath as presented by the anatomical relations in the individual case.

A second line of defense is then created by approximating Poupart's ligament to the internal oblique aponeurosis and conjoined tendon behind the cord, if this can be accomplished without tension. A pedicled strip of external oblique fascia is used as a continuous suture to bind these tissues and additional support is given by interrupted sutures of silk. This part of the repair was described in a previous publication¹ and is illustrated in Figure 2.

If, however, Poupart's ligament cannot be approximated to the tissues forming the mesial border of the inguinal triangle without tension, the space is bridged by weaving strips of fascia lata across it by the technique described by Galle.

It is important, regardless of the type of technique used, to include the triangular fascia in the

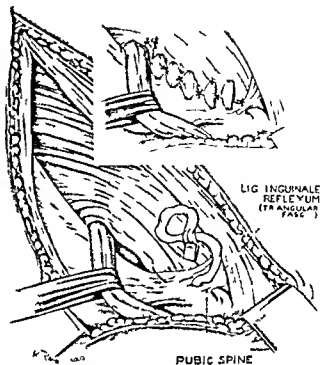


Fig 2. A second layer of support is added by approximating the borders of the inguinal triangle and binding them with a pedicled strip of external oblique fascia used as a continuous suture. If the borders cannot be approximated without tension strips of fascia lata are weaved between them after the technique of Galle.

lowermost suture to seal the area immediately above the pubic spine (Fig 2). The superficial fascia is approximated over the cord and the skin closed with interrupted inverted mattress sutures.

CONCLUSION

An operative technique for repair of direct inguinal hernia is reported. The operation appears to have certain mechanical merits.

¹Bisgard J. Dewey. Surg. Gynec. & Obst. 1939 68: 113.

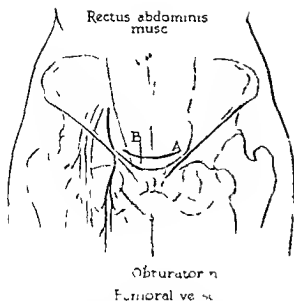


Fig. 1 Skin incision (Lancet) for exposure of the obturator nerve. B indicates the anterior sheath of the right rectus abdominis muscle.

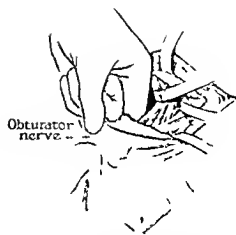


Fig. 3 Blunt extraperitoneal dissection with index finger along the posterior surface of the horizontal ramus of the pubis until the obturator nerve is palpated.

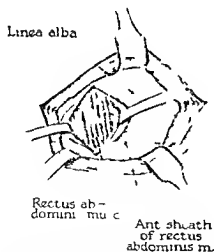


Fig. 2 Exposure of the lateral margin of the right rectus abdominis muscle.

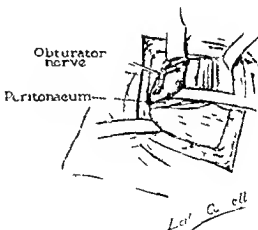


Fig. 4 Oblique view with peritoneum retracted medially to expose the right obturator nerve.

INTRAPELVIC EXTRAPERITONEAL RESECTION OF THE OBTURATOR NERVE

IREMONI A. CHANDLER, M.D., F.A.C.S., and FREDERICK S. MILLER, M.D.,
Chicago, Illinois

IN severe spastic paraplegia or hemiplegia, overactivity of the adductor muscles of the thigh is undoubtedly the greatest obstacle to useful functioning of the lower extremities. A "scissors" gait or position of the legs not only impedes progression but contributes to the development of deformities of the knee, ankle, and foot. The correction of the disabling overactivity of the adductor muscle groups by active and passive stretching with or without retention in plaster or by tenotomy or myotomy of the adductor groups has been extensively employed but with rather disappointing results. However, in cases presenting structural shortening of the adductor muscles, these procedures may be necessary.

The conversion of the rigid spastic state into that of a flaccid paralysis by neurectomy has been found to be most beneficial. In 1910, Stoffel studied the topography of the obturator nerve and in 1911 described an operation in which the branches of the obturator nerve were resected in the upper inner thigh. This has a number of disadvantages, namely, difficulty in keeping the wound clean, the possibility of a tender scar in this region, as well as the difficulty of locating both the anterior and posterior branches (some times 3 branches) of the nerve. In 1914, Selig gave an anatomical description of a proposed operation of intrapelvic extraperitoneal resection of the obturator nerve performed through a lateral abdominal incision. In 1921, Loeffler and Gocht resected the nerve by the extraperitoneal route, both by a partial resection of the insertion of the rectus abdominis muscle, the former using a mid line incision and the latter a Pfannenstiel incision. Their results were satisfactory. Bonnet, in 1932, resected the obturator nerve near its origin through a lateral abdominal incision locating the nerve upon the psoas muscle. In 1930, Wischniewsky presented a new operation in which he exposed the nerve through a vertical incision between the inner and middle thirds of the Poupart's ligament. The pectineal fascia was cut and the pectineus muscle released and retracted laterally exposing the fascia of the obturator externus. This fascia was incised and the branches of the obturator

nerve were exposed and resected. In 1936, Klimov described a partial resection of the obturator branches as well as the branch communicating with the sphenous nerve in cases of ulcer or gangrene of the leg. He exposed the nerve through a vertical incision on the upper inner thigh.

We have employed intrapelvic extraperitoneal resection of the obturator nerve in 54 instances at the Children's Memorial Hospital. The results have been so uniformly satisfactory that we are prompted to present the technique of the operation that we have evolved.

OPERATIVE TECHNIQUE

In bilateral resection of the main trunk of the obturator nerve a transverse (Pfannenstiel) incision is made through the skin and subcutaneous tissue of the lower abdomen following the normal transverse crease just above the pubis (Fig. 1A). The anterior fascia of the rectus abdominis muscle is exposed by blunt dissection. The anterior fascia or sheath of the rectus muscle is then split vertically over the center of its distal portion (Fig. 1B). The lateral portion of the rectus sheath is elevated and retracted laterally exposing the lateral margin of the muscle (Fig. 2). The rectus abdominis muscle is retracted medially and the fascia transversalis and the peritoneum exposed. The index finger is used as a blunt dissector following the posterior surface of the muscle to its insertion in the body and the horizontal ramus of the pubis, entering the space of Retzius which is filled with loose, fatty, areolar tissue (Fig. 3). The finger is then gently directed laterally and more deeply along the horizontal ramus of the pubis displacing the bladder and the lateral folds of the peritoneum posteriorly until the upper portion of the obturator fascia overlying the obturator internus muscle is palpated. The obturator nerve is then located as a small cord like structure on the inner pelvic wall just below the lower margin of the horizontal ramus of the pubic bone. One inch ribbon retractors are inserted extraperitoneally to hold the peritoneum and bladder medially. The fatty areolar tissue overlying the obturator nerve is opened with a forceps and the nerve exposed. The nerve may

be identified by stimulation and by its course as it enters the neural canal of the obturator fascia. The nerve is then separated from adjacent blood vessels and is elevated with a small blunt hook (Fig. 4). A ligature is placed at each of 2 levels to prevent bleeding and the intervening portion of the nerve is excised. Care must be taken not to tear any of the small veins of this area and the possibility of anomalous arteries must be kept in mind. After inspection of the wound for bleeding points the retractors are removed and the peritoneum permitted to fall back into place. The opposite side is exposed in a similar manner. The fascia, subcutaneous tissues and skin are sutured and a compression dressing applied. No cast is used. In unilateral cases a vertical lower rectus incision is preferred.

In our series no complications have arisen. The relaxation of the adductor groups by this method has been more satisfactory than by other operations which we have employed.

The advantages of the operative technique described above may be summarized in part as follows: (1) The main trunk of the obturator nerve is exposed satisfactorily with a minimal amount of trauma. (2) The incision is in a location least exposed to contamination and is also inconspicuous. (3) The incision of the fascia is supported by the rectus muscle reducing the possibility of hernias. (4) The retention of the legs in an abducted position by braces or casts is not necessary. (5) The active use of other muscle groups of the leg is not even temporarily impeded. (6) A satisfactory correction of adductor spasm is obtained.

BIBLIOGRAPHY

1. BOEREMA I. Obturator nerve resection in Littles disease. *Ztschr f orthop Chir* 1914 61 453-463.
2. BONNET J. La neurotomie du nerf obturateur a son origine dans la region lombo-iliaque par l'approche sous-peritoneale. *Lyon chir* 1932 29 558-562.
3. KLIMOV W. A. Ein operativer Zugang zum Nervus obturatorius. *Arch f klin Chir* 1916 183 350.
4. KOFMAN A. Eine Modifikation des Beckenzuganges zum Nervus obturatorius. *Arch f orthop u Unfall Chir* 1915 35 300-303.
5. KRETZ J. Zur intrapelvinen extraperitonealen Resektion des Nervus obturatorius nach Selig. *Arch f Orthop* 1921 10 212-220.
6. LAUENSTEIN C. Die Resektion des Nervus obturatorius zur Beseitigung der Adluctorenkontractur aus centraler Ursache. *Centralbl f Chir* 1897 19 21.
7. LERICHE R. De la neurotomie sous peritoneale du nerf obturateur. *Lyon mèl* 1914 122 1450-1461.
8. LOFFLER F. Treatment of adductor palsy by extraperitoneal pelvic resection of obturator nerve. *Zentralbl f Chir* 1921 45 4.
9. KOCHER H. L. Author's techniq for intrapelvic neurotomy. *J de mèl le Bordeaux* 1916 111 493.
10. SELIG K. Die intrapelvine extraperitoneale Resektion des Nervus obturatorius und anatomische Studien ueber die Topographie dieses Nerven. *Arch f klin Chir* 1914 103 904-1011.
11. Idem. Vorschlag zur extraperitonealen Resektion des Nervus obturatorius bei Spasmen der Adduktoren. *Ztschr f aug Anat* 1913 1 9.
12. STOFFEL A. Vorschlaege zur Behandlung der Clutanlahmungen Mittels Nervenplastik. *Deutsche Ztschr f Chir* 1910 10 241-262.
13. Idem. Leber Nervenuberpfanzung bei schlaffen Lahmungen. *Muenchen med Wchnschr* 1911 56 227-229.
14. WERTHEIMER P. Section of obturator nerve in therapy of spasmodic paralysis of childhood and adolescence. *oca es Lyon chir* 1934 31 746-759.
15. WISCHNIEWSKY A. Der operative Zugang zum Nervus obturatorius. *Arch f klin Chir* 1930 158 2-484.

AN INSTRUMENT TO MEASURE ARTERIAL PULSATION IN THE DIGITS

CLARENCE E. GARDNER, Jr., M.D., Durham, North Carolina

IN an effort to determine the condition of the circulation in the fingers and toes, an instrument has been constructed which measures arterial pulsations in the digits. It is an extremely sensitive, differential manometer constructed on the same principle as the Pachon oscillogometer. With it the magnitude of pulsations in the digits may be recorded under varying conditions of health and disease.

The instrument (Fig. 1) was constructed for us by Mr. William Hurst, instrument maker at the Duke University instrument shop. It consists of an air-tight chamber, *A*, within which is a small cup-like chamber, *B*, covered by a thin rubber diaphragm on which rests a small aluminum upright which, through a system of gears, operates a recording pointer. With the valve, *C*, open, pressure may be built up in a small cuff applied to a digit to any desired level, the pressure in chambers *A* and *B* being equalized. With the valve then closed, pressure variations caused by the digital pulse are recorded from oscillations of the pointer. The instrument is quite stable and is not affected by ordinary building or room vibrations. It has a sensitivity of 0.002 centimeter of mercury per millimeter scale division as compared to a sensitivity of 0.012 centimeter of mercury per millimeter scale in the Bouhite oscillogometer used to record pulsations in the arms and legs. It is capable of responding to impulses at the rate of 15 per second.

The instrument is portable; its operation is extremely simple and easy, requiring no technical skill, and it may be used with extremities in a water bath at various temperatures. In these respects, it adapts itself better to clinical use than the sensitive digital plethysmographs which have been devised by Johnson and by Turner.

Digital pulses have been found to vary with the constantly changing vasomotor reactions in each individual. Yet, with control of the environmental temperature by placing the extremity in a water bath at various temperatures, abstinence from smoking for at least 2 hours, and with the subject relaxed and composed at normal body temperature, readings are believed to give

a sufficiently reliable index of the efficiency of circulation in the digits for practical clinical use. The pneumatic cuff must be applied to the base of the finger in each case. And to eliminate the effect of reactive hyperemia following occlusion, the cuff is not left in place longer than 1 minute and readings are not repeated oftener than every 10 minutes.

To determine the effect of environmental temperature on the digital pulse, readings have been made on a series of normal adults with the arm and hand in a water bath at various temperatures. With the subject seated comfortably, the arm and hand are immersed in an arm tub at 45 degrees C. After 10 minutes, the cuff is applied to the index finger and inflated to 160 millimeters of mercury. Readings are made at this pressure and at 140, 120, 100, 80, 60, 40, and 20 millimeters of mercury. Temperature of the water in the arm tub is then dropped and after 10 minutes at each temperature, readings also made at 40, 35, 30, 25, and 20 degrees C. Chart 1 shows a typical curve obtained in this way. It will be seen that maximum pulsation occurs at about the diastolic pressure and at the higher temperature. As the temperature is dropped, the magnitude of pulsations changes little until the temperature of the bath is at 30 degrees C. when a significant re-

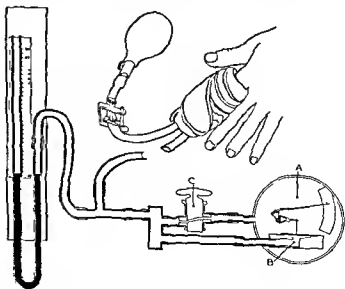


Fig. 1. Diagram of the digital oscillogometer.

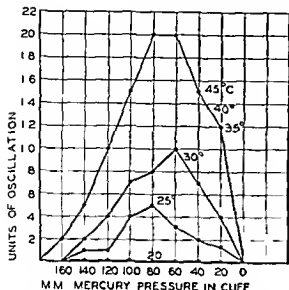


Chart 1 Chart of the digital oscillations of the right index finger of a normal adult aged 20 years with the arm and hand in a water bath at various temperatures. The blood pressure was 120/75. Pulsations were first charted at 41 degrees C. and then at decreasing increments of 5 degrees C. each to 20 degrees C. At 20 degrees C. pulsations were significantly reduced and at 20 degrees C. they were absent in indicating extreme vasoconstriction at this temperature.

duction occurs. At 0 degrees C. pulsations have either disappeared or are so feeble as to register only a fraction of a millimeter deflection of the needle.

Variations from this normal range of pulsations in the digits we believe will give valuable information in the recognition of obliterative or of vasospastic conditions in the digital vessels. Thus an obliterative process in the arteries may be expected if at full vasodilatation with the ex-

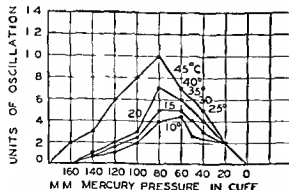


Chart 3 Chart of the digital oscillations of the left great toe 10 days after left plantar and left lumbar sympathectomy. Cold pulsations remain after the environmental temperature has been dropped to 10 degrees C.

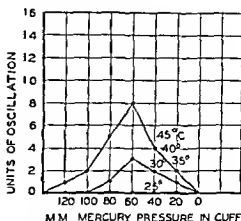


Chart 2 Chart of the digital oscillations in the right index finger of a man aged 54 years with sclerodactylia and Raynaud's syndrome. At the higher temperatures pulsations never reached the normal level. As the temperature was reduced pulsations disappeared at 25 degrees C. indicating a tendency to vasospasm at a higher environmental temperature than normal.

tremity in a warm bath the magnitude of pulsation fails to approximate a normal level. While with a normal range of pulsation at full vasodilatation disappearance of pulsations at temperatures higher than 20 degrees C. would indicate the presence of a pure vasospastic condition.

Chart 2 shows the pulsations in the index finger of a man age 54 with sclerodactylia and Raynaud's syndrome. Pulsations did not rise to a normal level on immersing the arm in a warm bath. This might be interpreted as being caused either by an obliterative process within the artery or because the inelastic and contracted integument of the finger failed to allow full pulsation. The fact that pulsations disappeared at a higher temperature than normal would indicate an in-

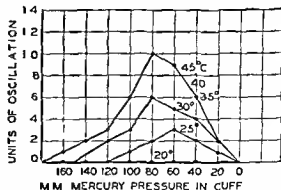


Chart 4 Chart of the digital oscillation of the right great toe of the same patient as in Chart 3. No sympathectomy has been done on this side. Pulsations were entirely obliterated at 20 degrees C.

creased sensitivity to cold, with vasospasm at a higher environmental temperature than normal.

Pulsations exactly similar to those in Chart 2 were observed in another patient, a male, aged 25 years, with typical Raynaud's syndrome but without sclerodactylia. The pulse at the wrist was normal as were oscillometric readings in the forearm and arm. The maximum digital oscillation at 45 degrees C was 7 millimeters and all pulsations had disappeared when the temperature of the arm tub was dropped to 25 degrees C. These readings would seem to indicate the presence of both an obliterative and a vasospastic element in the digital vessels such as is seen in the advanced stages of Raynaud's disease in which the digital arteries are narrowed by thickening of their intimal coats and are incapable of full expansion.

In most of the obliterative arterial diseases observed in the vascular disease clinic, pulsations in the major vessels at the wrist or ankle of the affected extremities cannot be felt and no digital pulsations can be recorded. One patient, a male, aged 45 years, with Buerger's disease and a gangrenous toe had palpable radial pulses at each wrist and maximum pulsations in the forearm as recorded with the Boullitte modification of the Pachon oscillometer of 2 units on the left and $1\frac{1}{2}$ on the right. Digital pulsations could not be obtained at any temperature on the right and were only faintly seen on the left at full vasodilatation. In a man of 66 years with arteriosclerotic gangrene of the right great toe, pulsations could be felt in the left posterior tibial and dorsalis pedis artery and maximum pulsations with the oscillometer on the left thigh were 9, and above the left ankle, $2\frac{1}{2}$. No pulsation could be detected in the left great toe at any temperature, indicating an advanced degree of obliteration of the digital arteries.

The effect of sympathectomy on the digital pulse in the great toe with foot and ankle in a

water bath at various temperatures is shown in Chart 3 as compared to pulsations in the unsympathectomized toe (Chart 4) of the same individual. The patient was a male, aged 20 years, in whom left splanchnic nerve resection and resection of first and second left lumbar sympathetic ganglia had been performed 10 days previously for Hirschsprung's disease. At room temperature, the left great toe showed a maximum oscillation of 10 millimeters while that in the right great toe was 4 millimeters. As shown in the charts, the sympathectomized toe continued to show good pulsations in a bath at 10 degrees C which was as low a temperature as the patient could comfortably stand, while in the toe not operated upon, the pulsations were feeble at 25 degrees C and had completely disappeared at 20 degrees C.

SUMMARY AND CONCLUSIONS

An instrument is presented which measures the magnitude of pulsations in the fingers and toes. Measurement of these pulsations at various environmental temperatures, it is believed, will give valuable assistance in the recognition of peripheral vascular diseases and in the differentiation of vasospastic from obliterative processes in the digital arteries.

In the preparation of the instrument described we wish to acknowledge with appreciation the valuable assistance of Dr J. L. Morgan, physician to the Duke Hospital.

REFERENCES

1. HURST, W. A sensitive differential manometer. *Rev. Scientific Instr.* 1930 10 27.
2. JOHNSON, CARL A. Studies on peripheral vascular phenomena: a new device for the study of peripheral vascular phenomena in health and disease. *Surg. Gynec. & Obst.* 1932 55 731.
3. TURNER, ROY H. Studies in the physiology of blood vessels in man: apparatus and methods. I. A sensitive plethysmophymograph for a portion of the finger. *J. Clin. Invest.* 1937 16 777.

A NEW OPERATION FOR METATARSALGIA AND SPAY-FOOT

ARTHUR KRIDA M.D. I.A.C.S. New York, New York

THE kind of foot in which the operation to be described is indicated is one which exhibits the signs of marked relaxation of the structures which hold the metatarsal region together. It has been called the spay-foot or spreizfuß. In this clinic we call it the metatarsalgic or accordion foot.

It is to be found in the main in women in third and fourth decades. It is based probably upon foot weakness in childhood. In adult life the holding together of the metatarsal region is accomplished in a manner by narrow shoes but further development of the relaxation is determined by the higher heel of feminine shoe apparel which throws an abnormal strain upon the anterior arch. Symptoms of metatarsalgia then make their appearance of which the Morton's toe and the feeling of walking on the bones are classical examples.

From the Department of Orthopedic Surgery, Bellevue Hospital (111 East 10th Street), University College of Medicine. Presented at the November 1917 meeting of the Orthopedic Section of New York Academy of Medicine and Philadelphia Orthopaedic Club.

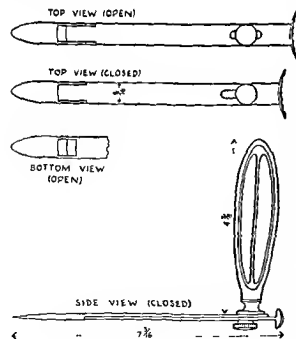


Fig. 1. The fascial introducer.

In time the narrow shoe is no longer adequate to hold the foot together because the first metatarsal head (and frequently the fifth) resent the pressure and respond by the development of more or less of a bunion. In the meantime a greater or lesser degree of hallux valgus has developed. In this stage the woman patient has a closet full of shoes with none of which she is entirely happy. This is entirely understandable because a shoe is no longer adequate.

The treatment which has heretofore been utilized in this type of foot is (1) support of the metatarsal arch by a suitable device (2) wider shoes with a lower heel (3) intensive development of the intrinsic foot musculature by exercises (4) some type of operation for the hallux valgus usually for the relief of the pressure symptoms of the extruded first and fifth metatarsal heads.

In some occasional urban communities it seems to be still possible to induce women in the age period mentioned to adopt a wide shoe with a low heel for habitual use. In my community I have found this to be largely unfeasible and when accomplished a rather thankless enterprise. As to the possibilities of the development of the intrinsic foot musculature such attempts are apt to be conducted in a half-hearted fashion and at best are vitiated by the inevitable return to the esthetically prized shoe as a means of personal adornment.

The encircling fascial band operation is advanced as a practicable means of holding such a foot together in a permanent way. It offers the assurance that recurrences following the usual operation for hallux valgus will not take place that hallux valgus may be prevented and that no artificial support of the metatarsal arch will be necessary.

In the last 20 months about 30 feet have been operated upon by this method with satisfactory outcome.

INSTRUMENT FOR PASSING FASCIAL BAND AND TECHNIQUE

The instrument that has been devised looks a good deal like the old Sluder tonsilotome. Its extremity is somewhat pointed and beveled so that it may be passed with a minimum of resistance through the soft tissues. The slot is about 1/4 inch in width and is equipped with fine

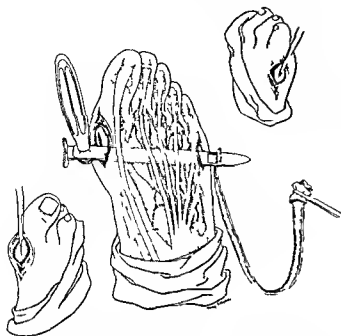


Fig. 2. Encircling the metatarsus with a flat fascial band. Curved incisions are made about the first and fifth metatarsal heads. Dorsal view.

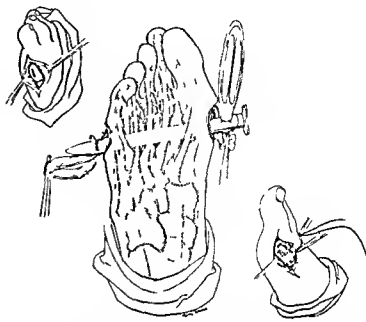


Fig. 3. The course of the band on the plantar aspect. The method of securing the ends of the band has been modified to include a fascial knot as indicated in the text.

teeth upon which the gliding top portion of the instrument impinges upon the fascia, thus holding it firmly.

The curved incisions are made about the first and fifth metatarsal heads with their convexity dorsally. The prominent extruded portions of the first and fifth metatarsal heads are excised with a chisel, and the sharp remaining edges are smoothed off. An incision is made in the thigh and a 5/8 inch wide strip of fascia lata about 8 inches in length is removed. The special instrument is introduced through the incision over the first metatarsal head and is passed across the forefoot deeply to all the extensor tendons and emerges through the incision over the fifth metatarsal head. The aperture of the instrument is opened and one end of the fascia is fixed in it and the instrument is drawn back carrying the fascia with it as a flat band. The instrument is passed across the foot on the plantar aspect and here the instrument passes deeply to the flexors of the great toe, then superficially to the flexors of the second, third, and fourth toes, and again

deeply to the flexor tendon of the fifth toe. The other end of the fascia is placed in the aperture and drawn across the foot through the inner incision. The forefoot is compressed by an assistant. The two ends of the fascia are split for a short distance into a wide portion and a narrow strip. A knot is tied with these narrow strips. The wide portion is overlapped and secured with several fine silk sutures. The level at which the fascial band is passed is just proximal to the metatarsal heads. The incisions are closed and covered with dressings. The foot is wrapped in several layers of sheet wadding, the great toe being wrapped separately. A firm flannel bandage is wound over this sheet wadding to maintain compression of the forefoot and to maintain the great toe in a moderately corrected position. This dressing is renewed after 5 days. At the end of 12 days the sutures are removed and the compression of the forefoot is maintained for 3 weeks longer by an encircling adhesive plaster dressing. Weight bearing is allowed after 3 weeks. No metatarsal support is used.

A NEW OPERATIVE PROCEDURE FOR REPAIR OF RUPTURED CRUCIAL LIGAMENTS OF THE KNEE JOINT

HARRY B. MACFAY, M.D., Rochester, Minnesota

In view of the numerous articles written on injury to the cruciate ligaments of the knee joint no attempt will be made herein to discuss the causative or pathological factors or the diagnosis of the condition. But to my knowledge the plastic procedures described herein for repair of this complication have not been presented previously.

For repair of the anterior cruciate ligament, the knee joint is exposed through a lateral parapatellar incision which allows inspection of the joint and preparation of the medial femoral condyle for reception of the reconstructed ligament. A second incision is made over the tendons of the medial hamstring group of muscles; the semitendinosus tendon is identified and severed at its musculotendinous junction. The belly of the muscle is then sutured to the semimembranosus muscle. The semitendinosus tendon is freed up to its point of attachment on the tibia. Through a hole made with a three sixteenth inch drill in the anterior aspect of the tibia, emerging at the origin of the anterior cruciate ligament, the tendon is passed through to the joint. Next a hole

is made through the lateral femoral condyle posteriorly, emerging from the posterior aspect of the inner condylar notch. The tendon is then drawn through and sutured to the periosteum. The knee is held in full extension while the tendon is being sutured (Fig. 1).

For repair of the posterior cruciate ligament of the knee a median parapatellar incision is used. The joint is inspected and the medial femoral condyle is prepared for reception of the new ligament. For repair of the posterior cruciate ligament the drill hole through the medial femoral condyle is placed well forward and an incision similar to the one previously described is used for obtaining the semitendinosus tendon. By blunt dissection the posteromedian aspect of the popliteal space is exposed. For accurate placing of the drill hole in the tibia, the hole in this instance to be drilled backward and outward from a position proximal to the site of insertion of the semitendinosus tendon, a Kirschner wire is used. When a Kirschner wire is used as a guide with exposure of the popliteal space, the procedure is carried out under direct vision and an accurate location is obtained. The tunnel in the tibia is

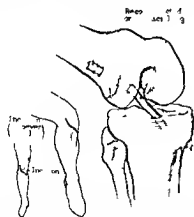
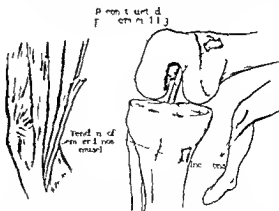


Fig. 1. Technique for repair of ruptured anterior cruciate ligament. Illustrating the lateral parapatellar incision for inspection of the joint and preparation of the medial femoral condyle for reception of the reconstructed anterior cruciate ligament. The incision over the medial hamstring group of muscles to sever the semitendinosus tendon and the holes ($\frac{3}{16}$ inch) extending through the anterior aspect of the tibia and the posterior portion of the lateral femoral



condyle through which the reconstructed anterior cruciate ligament is to be passed.

Fig. 2. Technique for repair of ruptured posterior cruciate ligament. Illustrating the median parapatellar incision for obtaining the semitendinosus tendon and the drill holes ($\frac{3}{16}$ inch) through the medial femoral condyle and the tibia and the correct flexion of the knee for suturing.

prepared by passing a three sixteenth inch drill over the wire. The tendon is then passed into the popliteal space. Through the anterior incision made in the knee joint a hole is punched through the capsule posteriorly and the tendon is pulled into the joint and passed through the medial femoral condyle. In suturing the tendon it is well to hold the knee in moderate flexion (Fig. 2).

After the repair of both the anterior and posterior cruciate ligaments of the knee is accomplished a plaster of Paris leg cast is applied and

is worn by the patient for about 4 weeks. On removal of the cast, physical therapy and active exercises are instituted. At the end of about 8 weeks full activity of the leg usually can be permitted. To hasten infiltration of the transplanted tendon with callus and to promote incorporation of the tendinous tissues into the bone, it is well to scarify the portions in the bony structure. This new procedure offers a normal anatomical reconstruction of the ligaments accomplished by a method which presents few technical difficulties.

A NEW OPERATIVE PROCEDURE FOR REPAIR OF RUPTURED CRUCIAL LIGAMENTS OF THE KNEE JOINT

HARRY B. MACFAY, M.D., Rochester, Minnesota

IN view of the numerous articles written on injury to the cruciate ligaments of the knee joint no attempt will be made herein to discuss the causative or pathological factors or the diagnosis of the condition. But to my knowledge the plastic procedures described herein for repair of this complication have not been presented previously.

For repair of the anterior cruciate ligament the knee joint is exposed through a lateral parapatellar incision which allows inspection of the joint and preparation of the medial femoral condyle for reception of the reconstructed ligament. A second incision is made over the tendons of the medial hamstring group of muscles; the semitendinosus tendon is identified and severed at its musculotendinous junction. The belly of the muscle is then sutured to the semimembranosus muscle. The semitendinosus tendon is freed up to its point of attachment on the tibia. Through a hole made with a three sixteenth inch drill in the anterior aspect of the tibia emerging at the origin of the anterior cruciate ligament the tendon is passed through into the joint. Next a hole

is made through the lateral femoral condyle posteriorly emerging from the posterior aspect of the inner condylar notch. The tendon is then drawn through and sutured to the periosteum. The knee is held in full extension while the tendon is being sutured (Fig. 1).

For repair of the posterior cruciate ligament of the knee a median parapatellar incision is used. The joint is inspected and the medial femoral condyle is prepared for reception of the new ligament. For repair of the posterior cruciate ligament the drill hole through the medial femoral condyle is placed well forward and an incision similar to the one previously described is used for obtaining the semitendinosus tendon. By blunt dissection the posteromedian aspect of the popliteal space is exposed. For accurate placing of the drill hole in the tibia the hole in this instance to be drilled backward and outward from a position proximal to the site of insertion of the semitendinosus tendon a Kirschner wire is used. When a Kirschner wire is used as a guide with exposure of the popliteal space the procedure is carried out under direct vision and an accurate location is obtained. The tunnel in the tibia is

From the Section of Orthopedic Surgery, The Mayo Clinic

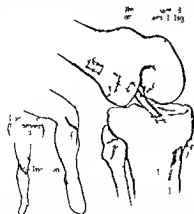
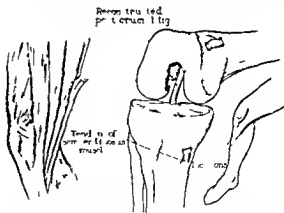


Fig. 1. Technique for repair of ruptured anterior cruciate ligament. Illustrating the lateral parapatellar incision for inspection of the joint and preparation of the medial femoral condyle for reception of the reconstructed anterior cruciate ligament. The incision over the medial hamstring group of muscles to sever the semitendinosus tendon and the holes ($\frac{3}{16}$ inch) extending through the anterior aspect of the tibia and the posterior portion of the lateral femoral



condyle through which the reconstructed anterior cruciate ligament is to be passed.

Fig. 2. Technique for repair of ruptured posterior cruciate ligament. Illustrating the median parapatellar incision, the incision for obtaining the semitendinosus tendon and the drill holes ($\frac{3}{16}$ inch) through the medial femoral condyle and the tibia and the correct flexion of the knee for suturing.

A SIMPLE METHOD FOR KEEPING DRY BLADDER FISTULAS FROM CERVIX CANCER

HARRY C. SALTZSTEIN, M.D., F.A.C.S., Detroit, Michigan

WHEN carcinoma of the cervix ulcerates into the floor of the bladder, a very disagreeable and uncomfortable condition ensues. To the infected necrotic cervix discharges is added the pooling of stagnant urine in the vagina, thus making this tender mucosa increasingly irritated, inflamed, and sore.

The care of this condition has been unsatisfactory. Transplantation of the ureters into the sigmoid has been considered, but at this stage of the disease the ureters are usually dilated from the stricture caused by cancer extension into the broad ligament and the prognosis for length of life is too uncertain (2 to 6 months) to make this extensive operation practicable. Bilateral lumbar ureterostomy has been done occasionally with success.

The employment of a permanent urethral catheter will keep some patients dry if the hole in the bladder is high up near the cervix and is not too large. Very often the catheter soon irritates the urethra, however, and the patient demands its removal. Locally, we have tried to keep these patients comfortable by means of rubber sheet and double pads placed underneath the hips and thighs, and by giving them a supply of perineal pads which they may change as frequently as necessary (every 20 to 40 minutes). Some have used a sea sponge in the vagina. Others have used an inflated toy balloon.

Urologists have, during the past few years, made increasing use of continuous suction to carry off the urine from draining bladder wounds. (1) The principles of applying suction to an open wound or orifice are that no vacuum be formed in the wound, and that there be no cupping action on the walls or bottom. (3)

Various devices have been described to fit on to the body surface comfortably in order to dispense with drainage tubes or for use when these tubes are not needed (1, 2, 4, 7). In all such devices a gauze wick lies in the urine or in the secretion to be absorbed. Air is sucked through a perforated catheter tube, or mask attached to the gauze. The suction pulls the urine through

the gauze, into the tubing, and then into a trap bottle.¹

The slightest suction or cupping pull in the vagina is painful, but a piece of gauze can be inserted into the vagina, attached to a perforated catheter outside the vaginal orifice, and the proper suction will transport the urine out into a bottle and keep the vagina clean. We have used the Hendrickson catheter attached to the Stedman electric suprapubic pump. This catheter ends in a flat spade like tube on one surface of which are 6 to 8 large perforations. A thick gauze wick is attached to this tube, and the free end is

¹Dr. William J. Sherman called our attention to these devices.

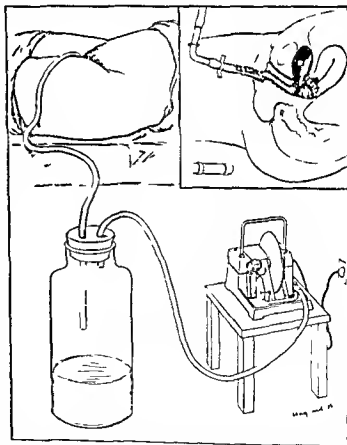


Fig. 1. Suction drainage applied to vagina for urinary fistula. Tubing from catheter is lead into a trap bottle to which mild suction is applied by means of a Stedman electric suprapubic pump. Insert in upper right shows gauze wick in vagina. The outer end of the gauze is held against the perforations in the end of the catheter. The catheter is taped on to the inner thigh and does not enter the vagina.

moistened and inserted 3 to 4 inches into the vagina. The catheter remains just outside the vagina. The tubing is then laid over the patient's thigh to a 1 gallon drain bottle on the floor. The pump is attached to the other tube of the bottle (Fig. 1).

The vaginal wick must be changed as it becomes soiled that is every 1 or 2 days. No other care is necessary except the routine cleansing of tubing and bottle (b) ¹

Th gh we h e t h d a p p t t t t r y t e f e e t h t
m i d d l e k e e p a t e s t n a t i o n a l i t h d n a e u n i q u e
l i b

BIBI IOCR M IN

1. DRAPFER JOHN W Methu (r upra pulic action
J L vol 103 33 411

- 2 HENDRICKSON, LLOYD C. A suction tip for use in cystostomy wound. *J Urol & Cutan Rev* 193 41 83
- 3 KENYON, JOSEPH H. Continuous suction and its application in postoperative treatment. *Surg Gynec & Obst* 1913 17, 115
- 4 LOWERY, O. S. and SAVOLLY, LEO. New suction device. *Am J Surg* 1935, 534
- 5 MCCARTHY, J. FRANK E. A consideration of supra-pubic prostaticotomy from the standpoint of operative technique and post-operative care. *Tr Am. A Genito-Urin Surg* 1928 21, 10
- 6 STEPHAN, HAROLD E. An inducible motor suction pump for drainage in urological cases. *J Urol* 1938 40 348
- 7 TILLOTSON, JAMES F. A device for controlling drainage of the bladder following cystostomy. *J Urol* 1936 38 466

THE SURGICAL TREATMENT OF INFILTRATING CARCINOMA OF THE BLADDER

EDWIN BEER, M.D. F.A.C.S., New York, New York

THIS paper will discuss briefly the best treatment for infiltrating carcinoma of the bladder. By best treatment I mean the treatment that gives the best end results. This treatment will naturally vary with the stage of the disease when the patient applies for treatment.

In those cases in which the tumor and involved bladder wall can be excised, this type of operative treatment, often involving a reimplantation of the ureter, gives the best results. In some of the more extensive growths total cystectomy, if feasible, gives surprisingly good results as judged by the criterion of 5 year cures. In other more or less extensive growths the introduction of radon seeds through a cystotomy or through a cystoscopy may have to be employed for one reason or another, such as the patient's poor general condition, poor kidney function, etc. This is always a hit or miss affair, as one cannot accurately delimit the extent of the infiltration process by sight or by palpation from within the bladder. Despite these handicaps, a small percentage of patients so treated seem to be definitely cured. The end results, however, are far inferior to those obtained in resectable cases. In addition to the group mentioned, there is an unfortunate series of neglected patients on whom no surgery is feasible, and in these we have to attempt to control the disease with deep roentgen therapy using the Coutard technique. As yet even at the Curie Institute, no cures have been accomplished with this therapy. Our cases have all been dismal failures, our hopes for this type of therapy in benign and malignant cases have not been realized, and according to the publications of Lacasagne (Curie Institute) his experience has been much the same as ours.

The various publications of more or less enthusiastic propagandists have confused members of the surgical profession as to the proper methods of approach to the question of the treatment to be applied in any particular case of tumor of the urinary bladder. That group of tumors, which are definitely malignant and which invade the bladder

wall or the projecting mass on the bladder wall, present therapeutic problems which are capable of being met only by the experienced surgeon, who is able to avail himself of the various surgical procedures as they are indicated. For those surgeons who see tumors of the bladder only occasionally, in view of the confusion in the literature, it becomes difficult to decide what to do. Many years ago to assist in the decision as to the proper therapeutic approach, the American Urological Association Registry was established to classify the results of the various efforts in therapy and to formulate a clearer understanding of what the proper therapy should be.

Those of us who have had an extensive series of cases (in our clinic we have treated almost 700 patients) have gradually come to a better understanding of the problem involved, and it is most encouraging to see that the last report of the Registry in 1936 confirms the conclusions that we have reached, namely, that surgical excision and resection gives the best end results.

Further confusion, in addition to that caused by the above type of propagandist, has been caused by the attempt of some few pathologists to group these tumors into 4 classes, calling the benign papillomas "Group 1 Carcinoma." Fortunately, Major R. O. Dart, who is acting as our registrar, has decided that this type of grading is not valid, accurate, or reliable, and recognizes only 3 types of epithelial bladder growths, as I have insisted for years. He says "For all practical purposes epithelial tumors of the bladder may be classified as (a) papillary, (b) papillary and infiltrating, and (c) infiltrating. Carcinoma of the bladder cannot be graded on the basis of cell differentiation alone. The most practical method of grading is based on a combination of physical findings and histopathological examination."

In our experience we have found, in agreement with the above, that there are on the one hand benign papillomas and on the other 2 types of carcinoma (1 A) papillary carcinoma with atypism

¹Surgeons under the influence of this type of pathological interpretation have repeatedly sent me patients and slides diagnosed incorrectly as carcinoma when trans cystoscopic therapy might have been applied in the patients' homes without the patients traveling hundreds or thousands of miles for the application of the proper therapy.

of cells plus invasion of the stroma and occasional lymph vessel thrombi (1 B) papillary tumors with the above characteristics plus an infiltration and invasion of the bladder wall to varying depths and (2) more or less solid, more or less nodular, infiltrating carcinoma running well into the bladder wall and occasionally extending widely in a horizontal direction.

An analysis of the results published by the Registry based on approximately 1400 cases of tumor of the bladder shows that in the treatment of infiltrating carcinoma the results by surgical therapy are infinitely better than by any other method. This is our experience as published in 1917 at the International Congress Brussels and later (1935) in my monograph (1) in which our cases were again studied. It is evident from the Registry's report that implantation of radon seeds through cystotomy wounds has given only 8.8 per cent of 5 year cures, whereas surgical partial cystectomy has produced 18.5 per cent of 5 year cures. From this it must be evident that those who rely entirely upon the use of radium are not giving the patients with infiltrating carcinoma of the bladder the care they deserve.

An analysis recently published (2) on total cystectomy in this disease shows that the more radical the surgery the higher the percentage of 5 year cures. In a series of 24 malignant tumors of the bladder in which a total cystectomy had been performed 6 patients died following the operation. Of the patients operated upon up to 5 years ago there were 11 cases with 2 operative deaths. The 9 patients surviving the operation showed a 53 per cent survival for 5 years and over. These results with total cystectomy in the most extensive bladder tumors point in the direction

which we have indicated i.e., that radical excision with or without reimplantation of the involved ureter obtains without a doubt the very best results. The 5 year cures in partial resection are less than after total cystectomy, probably because we were unable to make as complete a removal of all the microscopic deposits of cancer cells in the former instance. In 88 cases of carcinoma of the bladder, papillary and infiltrating we had an operative mortality of 15 cases. Sixty-five patients could be followed to test the value of this therapy and 74 patients were cured for 5 years which is twice as high as that reported in the Registry cases but as we have stated this is considerably less than are curable by total cystectomy. The results with the total cystectomy operation point the way for us and demonstrate conclusively to me that the more radical the operation in these infiltrating growths the better our results. For smaller infiltrating carcinomas we cannot as yet substitute total cystectomy and we must still adhere to partial cystectomy making wide resections so as to encompass the whole of the diseased area.

In closing let me again emphasize the importance of learning the technique of partial cystectomy with or without ureteral reimplantation as well as the technique of total cystectomy with implantation of the ureters in the skin or in the bowel as all other methods of approaching this most difficult problem are hit or miss affairs and do not give the patient a square deal.

BIBLIOGRAPHY

1. BEER, EDWIN. Tumors of the Urinary Bladder. New York: William Wood & Co. 1935.
2. Idem. *Am. J. Surg.* 1937 38: 192-200.
3. DART, R. O. *J. Urol.* 1936 36: 667.

EDITORIALS

SURGERY Gynecology and Obstetrics

FRANKLIN H. MARTIN
Founder and Managing Editor
1905-1935

LOYAL DAVIS, EDITOR

Associates

SUMNER L. KOCH

MICHAEL L. MASON

DONALD C. BALFOUR, *Associate Editorial Staff*

JULY 1939

THE QUESTION—ULCER OR CARCINOMA?

GRANTING that under medical treatment many patients with uncomplicated gastric ulcer are relieved of their symptoms and that there is a disappearance of roentgenological evidence of the ulcer, it is likewise well known that certain gastric ulcers complicated in one way or another do not respond satisfactorily to medical management. This is particularly true of an ulcer situated on the posterior gastric wall and which through protective perforation has invaded the pancreas. It is not the gastric ulcer, complicated by perforation, continued bleeding or recurrent massive hemorrhage, or persistent gastric retention in which much difference of opinion exists as to what the management shall be. Practically all internists and surgeons with particular interest in gastric lesions recognize these complications as more or less distinct indications for surgical intervention. It is the crater lesions with none of these complications in which there is lack of

unanimity of opinion as to what the appropriate treatment shall be. In many of these cases the question arises—what is the true nature of the lesion—benign ulcer or carcinoma?

The relationship of carcinoma to gastric ulcer is a matter which requires due consideration in many gastric lesions. The importance of this relationship lies not so conspicuously in the question of the frequency with which malignant degeneration in a benign gastric ulcer occurs. Sufficient evidence is at hand to indicate that such a change may and does occur often enough to be reckoned with in certain cases in which chronicity has been established and response to medical management has not been complete. A more absorbing problem in the ulcer carcinoma relationship is that of the difficulty not infrequently encountered in differentiating a benign ulcer from a carcinomatous ulcer or an early ulcerating carcinoma. In many instances the clinical, roentgenological, and gastroscopic findings in a gastric lesion leave considerable doubt as to just what the true nature of the lesion may be. Every surgeon of experience with gastric lesions has on occasion, with the abdomen open and with the lesion in his hand, felt uncertain as to whether it was a benign one or neoplastic. The benignancy or malignancy of the lesion can often be determined only by the competent pathologist.

The size and location of the lesion as depicted roentgenologically are of importance in differentiating the benign ulcer from the malignant lesion. While lesions with a crater of less than 2.5 centimeters in diameter are not all benign, and not all lesions of a greater diameter are malignant, nevertheless, the probability of malignancy in the latter lesions increases

proportionately to an increase in the diameter of the crater. Lesions of the greater curvature and of the anterior gastric wall are nearly always malignant. In lesions so situated few if any liberties are allowable so far as observation and medical management are concerned.

Appropriate to this discussion and pertinent to the problem of diagnosis the therapeutic test merits due consideration. As an aid in differentiating a benign ulcer from a malignant lesion it is not always a reliable one. Temporary clinical improvement has often been noted following dietary and other forms of medical management of ulcer when instituted in a patient harboring a gastric carcinoma and roentgenological and gastroscopic studies at repeated short intervals are subject to error in interpretation even by competent observers in these respective fields. The value of the test as a differential aid is dependent upon the selection of cases for its employment and upon the competency of interpretation of the observations at frequent intervals. It has been the experience of every gastric surgeon upon surgical exploration of patients in whom a medical regimen has been continued following faulty interpretation of the original therapeutic test to find inoperable carcinoma. The value of the test as an aid in the differential diagnosis of certain gastric lesions has been definitely established but adherence to the fundamental principles which includes adequate interim treatment, careful observation and competent interpretation is necessary for reliance.

Lack of improvement in the clinical and roentgenological manifestations following careful medical treatment and competent observation over a period of several weeks not only suggests that the lesion is not responding but also justifies uncertainty regarding the true nature of the lesion. Surgical intervention must be considered in cases in which such

uncertainty exists, and the urgency for surgical treatment is great when the evidence predominates in favor of a malignant lesion.

Unquestionably the ulcer carcinoma problem bears a direct relationship to the operability and curability of gastric carcinoma. Strange as it may seem the operability and curability of carcinoma of the stomach in general and by and large has shown little if any increase during the past 25 years. Today clinical inoperability is manifested in at least 50 per cent of the patients who harbor a malignant lesion of the stomach, and in at least half of those patients, in whom by clinical and roentgenological studies operability seems probable surgical exploration discloses wide extension of the disease in the stomach or to extragastric structures, precluding partial or total gastrectomy. In the remainder of the cases gastric resection is possible either as an operation curative in purpose or to provide palliation. Few surgeons have the opportunity through early recognition of the disease to perform gastric resection in 20 per cent of the people who harbor carcinoma of the stomach.

The gastric lesion is a medico roentgenologic surgical problem. Whatever the many factors may be which contribute to the present status of the operability of malignant lesions of the stomach the physician and internist occupy strategic positions in their relationships with patients. Only through evoking the aid of the competent roentgenologist may the physician most conclusively differentiate the functional from the organic gastric disturbance. Only through careful interpretation of clinical and roentgenological evidence and through early surgical intervention in all cases in which doubt exists as to the true nature of the lesion may the doubt be obviated and the curability of gastric carcinoma enhanced.

VERNE C. HUNT

EMBOLECTOMY FOR PERIPHERAL EMBOLISM

THE operative treatment of emboli in major peripheral vessels was developed by Linar Kev into a useful standard treatment for suitable cases before 1920. Especially following his address before the American College of Surgeons in 1924 the operation began to be used successfully in this country by a number of surgeons. By the early 1930's many surgeons in this country and Scandinavia and a few in England and on the Continent had had sufficient experience with the operation to save a very large proportion of the limbs operated upon. If done early, under eight to twelve hours, the circulation should be completely re-established in 50 to 75 per cent of the cases. The technique is not difficult for one trained in the use of fine silk (as many are today) and, from the patient's standpoint, it is a very easy operation. However, in 1933, wide publicity was given the use of alternating suction and pressure in the treatment of all forms of peripheral arterial occlusion and many patients were treated with a machine who might have had the embolus removed. No doubt patients with peripheral emboli have been saved from threatened gangrene following such treatment. However, no series of cases to date has been presented in such form that the results can be compared to the several series of surgical results that have been published. Even if acute gangrene is avoided by such treatment it is not unlikely that many cases have permanently impaired arterial circulation. Another medical treatment has also been recently suggested and used in many cases with results that are quite possibly not much better than the results of

no treatment at all. I refer to the use of anti-spasmodics such as papaverine. If those who advocated its use had ever seen an artery at operation for embolism with its diameter reduced fully one half by the spasm that takes place below the obstruction, they would not be sanguine about the good results of any drug that could safely be given. There is also, as well pointed out in the recent article by Griffiths,¹ the danger that an antispasmodic, if it is efficacious in promoting the downward movement of an embolus, might move it from a less dangerous to a more dangerous bifurcation.

Enough time has elapsed for definite proof of the efficiency of such medical treatments to be brought forth if such proof were available. Lacking it, it is high time that all surgeons return to embolectomy as the primary treatment of early cases of embolism located from the aorta to the popliteal space. Pressure and antispasmodic treatment may be given after operation if indicated. But embolectomy, because of the time factor, is never indicated if medical treatment is failing or has failed.

If patients are seen late, the indications are entirely different. Although Leriche advocates arterectomy as useful, it may well be that the "pressure boot" is the best treatment. Certainly embolectomy is not indicated. In these cases, however, one must keep in mind that long continued rest and protection from too much heat or cold are all important in the cases without gangrene. Early amputation as soon as a reasonable degree of demarkation has taken place is the only treatment for those with gangrene.

CHARLES C. LUND

¹Griffiths D. L. Arterial embolism. *Lancet* 1938 235 2339-44 see also editorial *Ibid* p 185

MEMOIRS

CHARLES H. MAYO

IN the death of Dr. Charles H. Mayo the surgical profession has suffered a grievous and irreparable loss. He was one of its outstanding leaders, a great surgeon who undoubtedly made more important contributions to the science of medicine than most men in the past generation—a famous man whom the world loved and respected, and a lovable man who carried his many honors and fame with great modesty.

It was my good fortune to have worked with him when there were but seven men on the staff of the Clinic at a time which afforded us a closer and a more intimate association with him and his distinguished brother than was given to the men who served in the Clinic after the staff had become so large. This very intimate association with him gave us fortunate men a splendid opportunity to become well acquainted with his many outstanding characteristics—his lovable and appealing personality—his keen mind—as well as his surgical brilliance.

He embodied everything that is noble and fine in a great physician. His love for his patients, the gentleness and patience he showed them during busy days when he was driven almost beyond the point of endurance, were outstanding traits. His knowledge of human psychology and his ability to relieve those racked with emotions and fears by his marvelous personality left an indelible imprint upon the minds of all of his associates. His keen analysis of suggestions and of new methods which were continuously being made in the rapid changes which were taking place in medicine at that time and the excellent judgment which he invariably showed in accepting only those methods and suggestions which later proved to be good was a source of wonderment to us all, and his own practical suggestions and the ingenious methods which he originated were legion.

His great versatility in the operating room was well known to all who ever attended his clinics. It was not unusual for him in a morning's work to cover practically the whole body and to explore most of its systems—all of his operations being performed with deftness and with an accuracy made possible by his broad knowledge of the anatomy, the physiology, and the pathology of the part under consideration, and invariably each operation was performed with conservatism, great gentleness, and with the dispatch of a master. As a diagnostician he was

unexcelled, often arriving at his conclusions by an uncanny intuitive sense apprehending obscure conditions unrecognizable by laboratory or mechanical aids

But the privilege of making rounds with him, of working with him during the afternoon hours in the Clinic, and of spending evenings with him in his home was just as instructive and I believe of as much value as assisting him in the operating room, for here his true greatness was shown in his love for his fellowman, his interest in his patients, in their problems as well as their diseases, his gentle consideration of the poor and unfortunate, his love for facts and his hatred of sham and subterfuge. Continuously in his work he practiced the true art of medicine to the highest degree

What a brilliant, wonderful man! How wide his interests! Great surgeon though he was, his views were not limited to the medical field but embraced a myriad of subjects to which he brought his keen discernment and understanding. He had a most unusual knowledge of mechanics and this he applied to his work, incorporating many practical and ingenious methods in the operations which he devised and originated. But an outstanding trait that everyone who knew or met him will long remember was his shrewd, dry wit, his delicious sense of humor, and a Will Rogers' way of expressing it. His presentation of deep scientific facts was never in the dry pedantic style, though packed with profound learning and wisdom. He always brought in some bit of homely philosophy, some excruciatingly funny witticism that left his audience breathless with laughter but left his point indelibly etched in their minds.

His home life was ideal. His great love for his devoted and wonderful wife, his children, his distinguished brother, and for his countless numbers of patients and friends was additional evidence of his greatness. Even after fame and world recognition came to him and he was showered with honors that have been given to few men in medicine, he was the same sweet, lovable, modest, and unspoiled Dr. Charlie that he was in the old days before all of these came to him. How few of us are big enough to bear recognition and fame in such a way!

Dear Dr. Charlie—what a heritage you have left and how much your life has benefited and enriched us! To the thousands of your patients who have been relieved and saved by your skill, to the countless numbers of physicians who have profited by your teachings, and to your legion of friends you shall always remain not only an inspiring and a stimulating influence but a sweet and lasting memory especially to your "old boys" who loved you and who will treasure that memory deep in their hearts to the end.

DONALD GUTHRIE

THE SURGEON'S LIBRARY

REVIEWS OF NEW BOOKS

THE W. B. Saunders Company offers the seventh edition of DeLee's *Principles and Practice of Obstetrics*.¹ In the preface to this edition the author states that 44 pages have been added but the care is chiefly for illustrations. He also states that every page has been worked over and obsolete matter has been omitted. It is a volume of over 1100 pages which contains 1277 illustrations.

This seventh edition has the same arrangement as the previous editions and like its predecessors presents a very exhaustive survey of each subject. There is a substitution for some of the illustrations such as Falkner's ovum for Herzog's which was reproduced in the sixth edition. It is noted that the former is included in color in another obstetrical text of recent edition. As in previous editions the bibliography is given at the end of each chapter rather than one complete bibliography at the end of the volume. It is DeLee's textbook brought up to date.

CHESTER C. DONERTY

IN the introduction to the book *Surgical Treatment of Hand and Forearm Infections*,² Dr T. Wingate Todd has written:

To both Dr. Brickel and myself it is a matter of the deepest dismay that at the very moment when we should have wished to consult with Dr. Kanavel on this important work Fate has intervened and left us to carry on without his constructive criticism and approval.

No one who knew Dr. Kanavel would doubt that he would have been the first to congratulate the author upon his efforts to extend our knowledge of the anatomy of the hand and the subject of infections and to express his gratification that other men were taking up the cudgels to help fight a battle which had always seemed to him of such great importance. Furthermore I think no one would doubt that he would have helped the author to correct some of the interpretations that he has made from his studies.

The first third of this very well illustrated volume is devoted to an anatomical study of the hand and forearm and is profusely illustrated with drawings of anatomical dissections and reproductions of roentgenograms made after injections of opaque materials into various sheaths and spaces. A finding that has impressed the author forcibly is the filling of a large space within the palm as a result of injection of the

tendon sheath of the fifth finger (Plates XX-XVII). This he has considered to be the ulnar bursa. He has ignored the fact that the ulnar bursa or to use a descriptive term the synovial sheath which invests the flexor tendon in the proximal portion of the palm except for that portion which continues distally about the flexor tendons of the little finger ends rather abruptly just distal to the middle of the metacarpus and does not continue distalward about the lumbrical muscles.

In the plates immediately following (XXIII and XXIV) the author shows the ulnar bursa fairly well outlined. The latter roentgenograms were obtained after injection of the exposed proximal end of the bursa. Both injections were stopped when the material began to leak from the opening previously made at the distal ends of the tendon sheaths of thumb and little finger. Surely if injected material leaked from the distal ends of tendon sheaths of thumb and little finger the ulnar bursa or the synovial sheath investing the flexor tendons in the palm should be filled and delineated. As a matter of fact it is and the picture shown in Plate XXIII and XXIV is very similar to the well known illustration in Kanavel's book (sixth edition p. 53 seventh edition p. 48) which shows the tendon sheaths of index middle and ring fingers and the radial and ulnar bursae after injection with a suspension of red lead and to Best's illustration showing the sheaths after injection with gelatin (Ann. Surg. 1930 80:31). However the injected space shown in Plates XXIII and XXIV has no similarity whatever to those shown in Plate XX-XXII. Why injection at one end of a synovial sac should give one picture and an injection at the other something entirely different is not explained.

The delineation of the synovial sheaths of the index middle and ring fingers is not clear in any of the plates. In Plate XXIII and XXI particularly there has been wide-spread extravasation into the soft tissues of the fingers as the result of attempted injections into the flexor sheaths. Nowhere is there seen a simple clear cut picture of the synovial sheaths of index middle and ring fingers such as shown in the illustration by Kanavel referred to above. There are two possible explanations for this failure: one that the needle or cannula slipped from the sheath. The result obtained would be comparable to the extravasation that occurs when a needle slips from or through a vein in an attempted intravenous injection. The other possible explanation is that the anatomical material used was so firmly fixed and hardened by chemical preservatives that

THE PRINCIPLE AND PRACTICE OF OBSTETRICS. 7th ed. Phil. & Lph. O. DeLee, Jr. W. B. Saunders Co. 1930.

Q. 75. 76. 77. 78. 79. 80. 81. 82. 83. 84. 85. 86. 87. 88. 89. 90. 91. 92. 93. 94. 95. 96. 97. 98. 99. 100. 101. 102. 103. 104. 105. 106. 107. 108. 109. 110. 111. 112. 113. 114. 115. 116. 117. 118. 119. 120. 121. 122. 123. 124. 125. 126. 127. 128. 129. 130. 131. 132. 133. 134. 135. 136. 137. 138. 139. 140. 141. 142. 143. 144. 145. 146. 147. 148. 149. 150. 151. 152. 153. 154. 155. 156. 157. 158. 159. 160. 161. 162. 163. 164. 165. 166. 167. 168. 169. 170. 171. 172. 173. 174. 175. 176. 177. 178. 179. 180. 181. 182. 183. 184. 185. 186. 187. 188. 189. 190. 191. 192. 193. 194. 195. 196. 197. 198. 199. 200. 201. 202. 203. 204. 205. 206. 207. 208. 209. 210. 211. 212. 213. 214. 215. 216. 217. 218. 219. 220. 221. 222. 223. 224. 225. 226. 227. 228. 229. 230. 231. 232. 233. 234. 235. 236. 237. 238. 239. 240. 241. 242. 243. 244. 245. 246. 247. 248. 249. 250. 251. 252. 253. 254. 255. 256. 257. 258. 259. 260. 261. 262. 263. 264. 265. 266. 267. 268. 269. 270. 271. 272. 273. 274. 275. 276. 277. 278. 279. 280. 281. 282. 283. 284. 285. 286. 287. 288. 289. 290. 291. 292. 293. 294. 295. 296. 297. 298. 299. 300. 301. 302. 303. 304. 305. 306. 307. 308. 309. 310. 311. 312. 313. 314. 315. 316. 317. 318. 319. 320. 321. 322. 323. 324. 325. 326. 327. 328. 329. 330. 331. 332. 333. 334. 335. 336. 337. 338. 339. 340. 341. 342. 343. 344. 345. 346. 347. 348. 349. 350. 351. 352. 353. 354. 355. 356. 357. 358. 359. 360. 361. 362. 363. 364. 365. 366. 367. 368. 369. 370. 371. 372. 373. 374. 375. 376. 377. 378. 379. 380. 381. 382. 383. 384. 385. 386. 387. 388. 389. 390. 391. 392. 393. 394. 395. 396. 397. 398. 399. 400. 401. 402. 403. 404. 405. 406. 407. 408. 409. 410. 411. 412. 413. 414. 415. 416. 417. 418. 419. 420. 421. 422. 423. 424. 425. 426. 427. 428. 429. 430. 431. 432. 433. 434. 435. 436. 437. 438. 439. 440. 441. 442. 443. 444. 445. 446. 447. 448. 449. 450. 451. 452. 453. 454. 455. 456. 457. 458. 459. 460. 461. 462. 463. 464. 465. 466. 467. 468. 469. 470. 471. 472. 473. 474. 475. 476. 477. 478. 479. 480. 481. 482. 483. 484. 485. 486. 487. 488. 489. 490. 491. 492. 493. 494. 495. 496. 497. 498. 499. 500. 501. 502. 503. 504. 505. 506. 507. 508. 509. 510. 511. 512. 513. 514. 515. 516. 517. 518. 519. 520. 521. 522. 523. 524. 525. 526. 527. 528. 529. 530. 531. 532. 533. 534. 535. 536. 537. 538. 539. 540. 541. 542. 543. 544. 545. 546. 547. 548. 549. 550. 551. 552. 553. 554. 555. 556. 557. 558. 559. 560. 561. 562. 563. 564. 565. 566. 567. 568. 569. 570. 571. 572. 573. 574. 575. 576. 577. 578. 579. 580. 581. 582. 583. 584. 585. 586. 587. 588. 589. 590. 591. 592. 593. 594. 595. 596. 597. 598. 599. 600. 601. 602. 603. 604. 605. 606. 607. 608. 609. 610. 611. 612. 613. 614. 615. 616. 617. 618. 619. 620. 621. 622. 623. 624. 625. 626. 627. 628. 629. 630. 631. 632. 633. 634. 635. 636. 637. 638. 639. 640. 641. 642. 643. 644. 645. 646. 647. 648. 649. 650. 651. 652. 653. 654. 655. 656. 657. 658. 659. 660. 661. 662. 663. 664. 665. 666. 667. 668. 669. 670. 671. 672. 673. 674. 675. 676. 677. 678. 679. 680. 681. 682. 683. 684. 685. 686. 687. 688. 689. 690. 691. 692. 693. 694. 695. 696. 697. 698. 699. 700. 701. 702. 703. 704. 705. 706. 707. 708. 709. 710. 711. 712. 713. 714. 715. 716. 717. 718. 719. 720. 721. 722. 723. 724. 725. 726. 727. 728. 729. 730. 731. 732. 733. 734. 735. 736. 737. 738. 739. 740. 741. 742. 743. 744. 745. 746. 747. 748. 749. 750. 751. 752. 753. 754. 755. 756. 757. 758. 759. 760. 761. 762. 763. 764. 765. 766. 767. 768. 769. 770. 771. 772. 773. 774. 775. 776. 777. 778. 779. 780. 781. 782. 783. 784. 785. 786. 787. 788. 789. 790. 791. 792. 793. 794. 795. 796. 797. 798. 799. 800. 801. 802. 803. 804. 805. 806. 807. 808. 809. 810. 811. 812. 813. 814. 815. 816. 817. 818. 819. 820. 821. 822. 823. 824. 825. 826. 827. 828. 829. 830. 831. 832. 833. 834. 835. 836. 837. 838. 839. 840. 841. 842. 843. 844. 845. 846. 847. 848. 849. 850. 851. 852. 853. 854. 855. 856. 857. 858. 859. 860. 861. 862. 863. 864. 865. 866. 867. 868. 869. 870. 871. 872. 873. 874. 875. 876. 877. 878. 879. 880. 881. 882. 883. 884. 885. 886. 887. 888. 889. 890. 891. 892. 893. 894. 895. 896. 897. 898. 899. 900. 901. 902. 903. 904. 905. 906. 907. 908. 909. 910. 911. 912. 913. 914. 915. 916. 917. 918. 919. 920. 921. 922. 923. 924. 925. 926. 927. 928. 929. 930. 931. 932. 933. 934. 935. 936. 937. 938. 939. 940. 941. 942. 943. 944. 945. 946. 947. 948. 949. 950. 951. 952. 953. 954. 955. 956. 957. 958. 959. 960. 961. 962. 963. 964. 965. 966. 967. 968. 969. 970. 971. 972. 973. 974. 975. 976. 977. 978. 979. 980. 981. 982. 983. 984. 985. 986. 987. 988. 989. 990. 991. 992. 993. 994. 995. 996. 997. 998. 999. 1000.

no injection of synovial sheaths in the fingers was possible. Anyone who has attempted only to straighten the flexed fingers of extremities "long pickled in brine" can appreciate how difficult it might be to demonstrate by injection the synovial sheaths in such a hand.

Since the tendon sheaths of index, middle or ring fingers were not filled with the injected material it is obvious why they did not rupture into the middle palmar space or thenar space as was demonstrated so graphically by Kanavel in his experimental studies and as has been demonstrated so often in a multitude of clinical cases. Injected material did rupture from the tendon sheath of the fifth finger into the palm and give the outline of the middle palmar space shown in Plates XX-XXII, and incorrectly called the ulnar bursa. Interestingly enough such rupture almost never occurs as a result of infection within the tendon sheath of this finger. We have seen many cases in which infection extended from the little finger into the ulnar bursa and fore arm but not a single case in which it ruptured from the sheath of the fifth finger into the palm. This fact again suggests the importance of checking by other methods conclusions drawn from experimental injections of anatomical material which may have been firmly fixed by chemical preservatives. These illustrations (Plates XX-XXII) do show graphically that material injected into the middle palmar space can pass lateralward beyond the middle metacarpal bone if no median septum is present to limit its spread if the septum is ruptured or if it is displaced (flattened) radialward and dorsalward by the injected material. This was emphasized by Iselin and his illustration of the injected "deep middle palmar space" (espace palmaire median profond) is identical with that shown in the author's Plates XX and XXI.

The author ignores the fact that Kanavel demonstrated that injected material which ruptures from the overdilated tendon sheath of the index finger fills the thenar space. Dr. Brickel has pictured a space (Plate XXX) which he calls the adductor space (a good name) resulting from injection of opaque material "at the distal edge of the thumb web" the shadow of the main mass of injected material lies to the radial side of the third metacarpal bone corresponding to what some authors call the thenar space. Subsequent dissection of the hand showed that the material was confined to the fascia and body of the adductor pollicis.

In spite of the fact that the author points out that the mass lies to the radial side of the metacarpal bone and that the illustration as well as the following plate (XXXI) show this definite line of demarcation he states elsewhere "we have never found a special palmar septum dividing the palmar foyer into halves" (p. 98) and, "We have never seen in our dissections or injection experiments a septum in the palm running from the palmar fascia to the middle metacarpal bone. In support of this observation

an independent dissection was made for the author during the summer of 1937 by Dr. Schmeidel, Professor of Anatomy at the University of Vienna" (pp. 158-159). How the injected material shown in Plates XXX and XXXI (the form assumed by the injected material and its position are identical in the two figures) remains confined to the area radial to the third metacarpal bone if there is "no septum dividing the palmar foyer" is not explained.

The last two thirds of the volume are devoted to a discussion of various types of infection and their treatment. In the discussion of general principles there are many statements with which we would wholeheartedly agree. "Local anesthetics have definite drawbacks. Encircling injections into the base of the finger with the application of a tourniquet to hold in the anesthetic is dangerous because gangrene of a finger may result. Injections of local anesthetics into the finger tip are especially to be avoided because distention of the tissues is very painful and likely to cause necrosis." "Ethyl chloride spray as a local anesthetic has nothing to commend it. We do not favor local injections, block or brachial anesthesia."

No mention is made of the invaluable blood pressure band to secure a bloodless field during operation and little attention is given the importance of careful and complete immobilization as a part of the after care or of methods of securing immobilization, and to the important principles of simple surgical cleanliness—of aseptic care of infected hands in the days following separation.

In a discussion of infections of the finger tip it is stated "An abscess in the bone must be curetted."

If no surgical attempt is made to eradicate the sequestrum a long period of distress and disability is certain to follow" (p. 115). "Where the bone is affected superficial abscesses may be curetted and the site of the abscess cauterized with carbolic acid and washed off with alcohol or glycerin. Care must be taken to limit the necrosis resulting from use of phenol" (p. 134), and in a discussion entitled "Infections of the Bones and Joints" one reads, "To curette infected areas in the bone is unwise. It is hard to know how much of the bone is actually diseased because soft, mushy, demineralized bone is present in the immediate vicinity of the infected bone. It is much better to provide adequate drainage and to await the formation of sequestra."

With the last of these three statements we would agree completely, but in the face of such conflicting statements how will the "seeker after knowledge" be able to choose the proper treatment? Surely there is no difference in the treatment of bone infection in the distal phalanx and in a metacarpal or carpal bone, and it is difficult to see any difference between the use of phenol with its resulting necrosis and the boiling oil which Pare abandoned so long ago.

The author has devoted a considerable portion of the space available for clinical considerations to the simple infections. In this he has doubtless chosen wisely, for the simple infections are the common

THE book, *Surgery of Oral and Facial Diseases and Malformations*,¹ represents a compilation entailing an earnest effort to condense the meat of a tremendous field into a reasonable volume. In the main, the book fulfills the requirements of a textbook, in that it is authentic and presents the subject matter in acceptable form, readable, and profusely illustrated. The illustrations are good with the exception of the roentgenograms and some of the line drawings; these do not adequately illustrate the author's own operations.

The arrangement of the text is unusual. Opening with a chapter on anesthesia, hemorrhage, blood transfusion and shock, the outline plan is extended

along familiar lines. The chapter dealing with diseases of the nervous system is acceptable and rarely found in a book of this kind. The vexed subject of focal infection of oral origin is dealt with in a common sense manner, and food for thought is provided the specialists in orthodontia.

Consideration of plastic surgery as a specialty is taken up in a readable form, and the author presents procedures adopted by himself and those in authority in a manner designed to make the book a useful reference volume.

The book cannot be recommended wholeheartedly as a textbook for dental students because they are concerned particularly with essentials and not with major surgical procedures for which they are not trained. On the other hand as a guide to dental and medical practitioners and surgeons, the book may be read with profit. F. W. McBRIDE

¹ THE SURGERY OF ORAL AND FACIAL DISEASES AND MALFORMATIONS. THEIR DIAGNOSIS AND TREATMENT INCLUDING PLASTIC SURGICAL RECONSTRUCTION. By George Van Ingen Brown, D.D.S., M.D., C.M.F.A.C.S. 4th rev. ed. Philadelphia: Lea & Febiger, 1933.

BOOKS RECEIVED

Books received are acknowledged in this department and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

A BIOGRAPHY OF THE WRITINGS OF HARVEY CUSHING Prepared on the Occasion of his Seventieth Birthday, April 8, 1910. By the Harvey Cushing Society. Springfield, Illinois and Baltimore, Maryland: Charles C. Thomas, 1930.

FEVER AND PSYCHOSES. A STUDY OF THE LITERATURE AND CURRENT OPINION ON THE EFFECTS OF FEVER ON CERTAIN PSYCHOSES AND EPILEPSY. By (Lady) C. Terry. New York and London: Paul B. Hoeber, Inc., 1930.

THE MEDICAL STAFF IN THE HOSPITAL. By Thomas Ritchie Ponton, B.A., M.D. Chicago: Physicians Record Co., 1930.

CLINICAL PATHOLOGICAL GYNECOLOGY. By J. Thornwell Witherspoon, B.S., B.A. and M.A. (Oxon), M.D. Philadelphia: Lea & Febiger, 1930.

TECNICA DEL TRATAMIENTO RACIONAL DE LAS FRACTURAS Y LUXACIONES. By Lisandro Leyva Pereira. Bogotá: Colombia Editorial Centro, 1937.

OXFORD MEDICAL PUBLICATIONS. HANDBOOK OF THE VACCINE TREATMENT OF CHRONIC RHEUMATIC DISEASES. By H. Warren (Oxon), D.M., B.Ch. (Oxon), M.R.C.S. L.R.C.P. 3d ed. London: Oxford University Press, 1930.

COLLECTED PAPERS BY MEMBERS OF THE GYNECOLOGICAL DEPARTMENT OF THE JOHNS HOPKINS HOSPITAL AND UNIVERSITY, 1929 to 1938. Vols. A and B.

WHAT IT MEANS TO BE A DOCTOR. By Dwight Underwood. New York: Medical Society of the State of New York, 1930.

TEXTBOOK OF GENERAL SURGERY. By Warren H. Cole, M.D., F.A.C.S. and Robert Elman, M.D. 2d ed. New York and London: D. Appleton-Century Co., Inc., 1930.

SEX AND INTERNAL SECRETIONS: A SURVEY OF RECENT RESEARCH. Edited by Edgar Allen Challen, H. Danforth and Edward A. Dorsey. With forewords by Robert M. Yerkes. Baltimore: The Williams & Wilkins Co., 1930.

THE PATIENT AS A PERSON: A STUDY OF THE SOCIAL ASPECTS OF ILLNESS. By G. Canby Robinson, M.D., LL.D., Sc.D. New York: The Commonwealth Fund, 1930.

LA MORT DES BRÛLÉS ET DE L'ENFERMEMENTAL. By Dr. Louis Christophe. Paris: Masson et Cie, 1930.

CIRURGIA DO MEGAFISÓFAGO. By Edmundo Vasconcelos and Gabriel Botelho. São Paulo: Brazil Companhia Editora Nacional, 1937.

RURAL MEDICINE. Proceedings of the Conference Held at Cooperstown, New York, October 7 and 8, 1930. Springfield, Ill. and Baltimore, Md.: Charles C. Thomas, 1930.

CIRUGIA RENAL CONSERVADORA. By Francisco E. Grimaldi. Buenos Aires: Juan Vincente y Cia. Editores, 1930.

CANCER HANDBOOK OF THE TUMOR (LINT) CANCER. UNIVERSITY SCHOOL OF MEDICINE. Edited by Eric Lilienkrantz, M.D. Stanford University: Calif. Stanford University Press, 1930.

RECENT ADVANCES IN OBSTETRICS AND GYNAECOLOGY. By Mack W. Bourne, M.A., M.B., B.Ch. (Camb.), F.R.C.S. (Eng.), F.R.C.O.G. and Leslie H. Williams, M.D., M.S. (Lond.), F.R.C.S. (Eng.), F.R.C.O.G. 4th ed. Philadelphia: P. Blakiston's Son & Co., Inc., 1930.

CHRONIC ARTHRITIS. By Robert T. Monroe, A.B., M.D. (Reprinted from Oxford Loose Leaf Medicine). Edited by Henry A. Christian, A.M., M.D., LL.D., Sc.D. (Hon.), F.R.C.P. (Hon.). New York, London and Toronto: Oxford University Press, 1930.

DISEASES OF THE NOSE AND THROAT. By Charles J. Imperatori, M.D., F.A.C.S. and Herman J. Burman, M.D., F.A.C.S. 2d ed. Philadelphia: London and Montreal: J. B. Lippincott Co., 1930.

MENSTRUAL DISORDERS: PATHOLOGY, DIAGNOSIS AND TREATMENT. By C. Frederic Fuhrmann, B.A., M.D., C.M. Philadelphia and London: W. B. Saunders Co., 1930.

ENDOCRINOLOGY IN MODERN PRACTICE. By William Wolf, M.D., M.S. 1st ed. rev. ed. Philadelphia and London: W. B. Saunders Co., 1930.

PRACTICAL SURGICAL HANDBOOK. Edited by Hamilton Bailey, F.R.C.S. (Eng.). 11th ed. Baltimore: The Williams & Wilkins Co., 1930.

A DESCRIPTIVE ATLAS OF RADIOGRAPHS: AN AID TO MODERN CLINICAL METHODS. By A. P. Bertwistle, M.B., Ch.B., F.R.C.S. Ed. 4th rev. enl. ed. St. Louis: The C. V. Mosby Co., 1930.

POSITIONING IN RADIOGRAPHS. By K. C. Clark, F.S.K. St. Louis: The C. V. Mosby Co., 1930.

CORRESPONDENCE

THE AMERICAN CONGRESS ON OBSTETRICS AND GYNECOLOGY

PREPARATIONS are being rapidly completed for the first American Congress on Obstetrics and Gynecology to be held in Cleveland the week of September 11, 1939. This meeting should be extremely profitable to everyone who has any interest in gynecology or maternal and infant care. This American Congress was planned to provide an opportunity to study and to correlate all the many problems in these special fields. Such a meeting was suggested by the Central Association of Obstetricians and Gynecologists. Its planning and successful organization has been carried out by the American Committee on Maternal Welfare with Dr. Fred L. Adair of Chicago as chairman. It has had the active support of national and local organizations interested in this work. The following societies have contributed active workers and financial aid: American College of Surgeons, American Association of Obstetricians, Gynecologists and Abdominal Surgeons, American Gynecological Society, American Hospital Association, American Medical Association, Section on Obstetrics and Gynecology, American Medical Women's Association, American Nurses Association, American Protestant Hospital Association, American Public Health Association, Catholic Hospital Association, Central Association of Obstetricians and Gynecologists, Chicago Maternity Center, Maternity Center Association of New York, National League of Nursing Education, National Medical Association, National Organization of Public Health Nursing, New England Obstetrical and Gynecological Society, Pacific Coast Society of Obstetrics and Gynecology, Southern Medical Association, U. S. Bureau of the Census, U. S. Children's Bureau, U. S. Public Health Service, Chicago Gynecological Society, Detroit Obstetrical Society, Illinois State Nurses Association, Minnesota Obstetrical and Gynecological Society, New Orleans Gynecological and Obstetrical Society, New York Obstetrical Society, Pittsburgh Obstetrical and Gynecological Society, Texas Association of Gynecologists and Obstetricians, and the Obstetrical Society of Boston.

The Congress will afford the first opportunity to all the professional personnel interested in the

problems of obstetrics and gynecology to meet together for a discussion of the various phases of maternal and infant care and to correlate these problems. To this end doctors, nurses, public health workers and hospital administrators and educational leaders are invited to participate. These separate groups have arranged unusually comprehensive programs in their own special fields and have integrated their problems with those of the other groups.

The general plans of the meetings will provide separate morning sessions for doctors, nurses and public health workers. Noonday round table discussions will provide an opportunity for more informal consideration of important subjects. The afternoon meetings will bring together all of the members of the Congress in programs of general interest to the entire group. Evening meetings will be of general interest and will be broadcast. Outstanding individuals outside of the field of medicine will present the social implications of the problems of reproduction to the Congress.

The medical program will include round tables and discussions of obstetrical and gynecological subjects by leading specialists. Monday morning will be devoted to medical and surgical complications of pregnancy. Tuesday morning to gynecological complications. Wednesday morning to the problems of labor. Endocrinology in obstetrics and gynecology, including the subject of sterility, will be presented Thursday and Friday morning will be given over to a discussion of infection in obstetrics and gynecology. A round table discussion will be offered every day on each of the following subjects: Toxemia of pregnancy, genital infections, obstetrical and gynecological hemorrhages, the fetus and the newborn, anesthesia, analgesia and amnesia in labor. These subjects will be repeated daily under the chairmanship of a clinician who has made outstanding contributions on the subject. This will therefore give an opportunity to a maximum number of individuals to attend these round table discussions.

The section on public health will present a similar program. The subjects to be covered in the morning meetings are the following: Public health and maternal care, maternal care in the

rural areas, federal and state programs in maternal care, maternal care and economics, education and maternal care. The afternoon meetings of component groups attending the Congress will correlate all the subjects which have been considered at the morning meetings of special groups.

The scientific exhibit which is to be held in conjunction with the Congress will be unusually comprehensive. New developments in obstetrics and gynecology will be presented and illustrated by diagrams, pictures, models, and moving pictures. Although investigations underway in the large teaching centers will predominate in this exhibit, some of the exhibits will have a wider scope in that they will attempt to portray the relationship of the problems of reproduction to the profession and to the general public.

The Congress should stimulate the development of state and local programs for better care for mothers and babies. It should likewise direct public attention favorably toward these problems and their successful solution by the profession. Thus, it should prove to be a force for tremendous good in bringing the public and profession together in the best interests of both.

In order to achieve the greatest good the Congress must have a wide representation. The entire medical profession is cordially invited to membership. The general practitioner, in particular, is urged to attend for he will find the meetings will provide him with a week's intensive instruction in all the phases of obstetrics and gynecology. Nurses and hospital administrators should likewise be urged by their medical staffs to attend.

The nominal registration fee of \$5.00 includes a year's membership in the American Committee on Maternal Welfare. All interested individuals are urged to send in their registrations in the American Congress on Obstetrics and Gynecology to the headquarters' office, 650 Rush Street, Chicago, Illinois. Checks should be made payable to Dr. R. W. Holmes, Treasurer. A detailed program of the meetings and scientific exhibits will be mailed on request.

M. EDWARD DAVIS, M.D.

A NEW AND SAFER METHOD OF CITRATED BLOOD TRANSFUSION

THE statement in a paper entitled "A New and Safer Method of Citrated Blood Transfusion" by Hustin and Dumont that "one of them (Hustin) advocated the citrate method for the first time 25 years ago" requires correction.

Hustin (April 1914) used sodium citrate in blood transfusion but in order to prevent coagulation he

felt it was necessary to mix the blood with an equal volume of glucose solution. Thus as Hedon (1917) stated, "Hustin mixed in equal parts blood with 150 tonic glucose salt solution, containing a certain proportion of sodium citrate and injected this mixture in small quantities. Hustin's method of transfusion is really an infusion of strongly diluted blood mixed with citrate of soda and glucose."

It was only after Agote and I (January 1915), working independently and contemporaneously, showed that undiluted citrated blood could be used for blood transfusion that the method had any practical value. This statement of facts shows very definitely that Hustin cannot be justly considered as the author of the citrate method. Questions of priority are of minor importance but questions of technique interest not only those who have helped in the development of a new method, but are of great importance to the profession at large. For this reason the fact that Hustin and Dumont claim to present a "safer" method of citrated blood transfusion requires careful investigation.

At Mount Sinai Hospital and in most hospitals in this country the technique which I described nearly 25 years ago is still used today with one important modification. Instead of the original piece of glass tube a connecting piece with a dropper is used in order to employ the intravenous drip method for blood transfusion. The intravenous drip method of infusion was first used by Friedemann over 25 years ago. The provision for Friedemann's continuous intravenous drip is the only important change which we have made in the original apparatus for citrate transfusion in 25 years.

The method as we have used it at this Hospital since 1915 represents an open method. Ever since its introduction in 1915 attempts have been made by others to introduce closed methods. People thought that the frequency of chills which were formerly encountered following citrate transfusions might be due to infection through the air. Naturally all closed methods are much more complicated than the open method which consists of a glass jar and an infusion flask. Since Rosenthal showed that chills are due to foreign proteins and to defects in the distillation of the water, closed methods have practically been abandoned. Rosenthal showed that careful cleansing of the instruments, tubing, and glassware immediately after the transfusion is essential for the prevention of chills. Since this technique was introduced at Mount Sinai Hospital in 1932 the chills dropped from 12 per cent to 1 per cent and have stayed on that level ever since. In 1937 1699 citrate transfusions were given in the wards of Mount Sinai Hospital.

Hustin and Dumont have devised a new apparatus (closed method) to which they add a propelling machine on the Carrel principle. The fact that with this complicated apparatus the incidence of chills was three times as high as with the open method will naturally stand in the way of its popularization.

RICHARD LEWISohn, M.D.

CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

HOWARD C. NAFFZIGER San Francisco *President*

GEORGE P. MULLER Philadelphia *President Elect*

Committee on Arrangements

THOMAS A. SHALLOW, *Chairman* L. BRAEFER FERGUSON *Secretary*

PLANS FOR 1939 CLINICAL CONGRESS IN PHILADELPHIA

FOR the twenty ninth annual Clinical Congress of the American College of Surgeons the surgeons of Philadelphia are planning to present a program of operative clinics and demonstrations that will include all phases of their clinical activities in this great medical center.

During the five days October 16-20 the clinicians at the five medical schools and more than 40 hospitals participating in the program will demonstrate to the fellows and their guests the latest advances in surgical technique and operative procedures. A preliminary schedule of the clinics and demonstrations at the hospitals and medical schools was published in the June issue of this journal and will be republished in later issues as the program is revised and amplified during the months preceding the Congress. Clinics will be held on the afternoon of Monday, October 16 and the mornings and afternoons of each of the following four days.

The program presents an ample and well arranged schedule of operative clinics at which the technique of a wide variety of surgical procedures will be demonstrated. In addition the committee is arranging a series of non-operative clinics in many of the large hospitals for the presentation of important work being done in many special fields. Demonstrations and exhibits will cover many phases in general surgery, genito-urinary surgery, neurosurgery, obstetrics and gynecology, fractures and other traumas, surgery of the bones and joints, thoracic surgery, broncho-esophagology, plastic and faciomaxillary surgery and surgery of the eye, ear, nose and throat. The hospital schedules will be so correlated that the visiting surgeon will be assured of an opportunity to devote his time continuously, if he so desires, to clinics dealing with the special subject in which he

is most interested. In the final program the clinical schedules will be classified according to various specialties in order to aid the visiting surgeon in selecting the clinics which he desires to attend. An accurate detailed clinical program will be posted in the form of bulletins at headquarters each afternoon for the succeeding day and published in printed form for distribution each morning.

The annual meeting of the governors and fellows of the College will be held in the Rose Garden of the Bellevue Stratford Hotel on Thursday afternoon at 1:30 o'clock. Reports on activities of the College will be presented by the officers and chairmen of the standing committees.

The meetings of three important state and provincial committees are to be held on Wednesday forenoon in the Palm Garden on the first floor of the hotel as follows: Judiciary committees 9:30, Credentials committees 10, Executive committees 11.

As the showing of surgical motion picture films so faithfully depicts clinical features of major interest to surgeons it is planned to present at this year's Congress an enlarged program of both sound and silent pictures at daily exhibits in the Palm Garden of the headquarters hotel.

SCIENTIFIC SESSIONS

The scientific sessions will include certain new features introduced at the Congress in recent years which have met with desired success. The schedule of midday panel discussions has been greatly extended in order that a larger number of the visiting surgeons may have an opportunity to participate.

On Monday the initiates will assemble in the Palm Garden at 11 a.m. in order that the officials

of the College may meet them and explain in some detail the aims and objectives of the program of the College. At this same session, the fellowship roll will be signed by the initiates. In the evening, at the Academy of Music, the Presidential Meeting and Convocation will be combined and at this time the new officers inaugurated and the initiates received into fellowship. Dr. Howard C. Naffziger, of San Francisco, will deliver the presidential address, and distinguished surgeons from foreign countries will be introduced.

Scientific meetings will be held in Irvine Hall of the University of Pennsylvania on Tuesday, Wednesday and Thursday evenings, at which eminent surgeons of the United States and Canada, with the co-operation of internists, will present various phases of the interesting subjects which have been selected for discussion.

As in former years, afternoon symposia have been arranged on the subjects of cancer, fractures and other traumas, urology, obstetrics and gynecology, and thoracic surgery.

A special feature of the program includes a series of clinical demonstrations to be held at headquarters each morning for those visitors interested in the subjects of ophthalmology and otorhinolaryngology. The subcommittees in charge of these special arrangements are also planning extensive programs of operative and dry clinics in surgery of the eye, ear, nose, and throat to be held in the hospitals each afternoon. Programs for special evening sessions of these groups are being prepared for Tuesday and Thursday evenings.

The midday panel discussions have become of such major interest as a feature of the Congress that the series for this year's meeting will include fifteen such sessions in large well lighted rooms. The program will permit the formal and informal discussion of subjects in more restricted fields than would be susceptible of treatment in the general meetings. Attendance at these conferences will necessarily be restricted to the capacity of the rooms in which they will be held. Outstanding authorities have co-operated with the College in the presentation of each one of the selected subjects and will lead, direct and participate in these discussions. The general plan to be followed is that the leader will present the subject to be discussed within a ten minute period, and selected men will discuss various phases of these topics briefly after which general discussion from the floor will be encouraged.

The program committee has aimed to include a selection of material at these various scientific meetings which will make it possible for all of the

general surgeons and surgical specialists attending the Congress to learn of the newer developments in their respective specialties.

GRADUATE TRAINING FOR SURGERY

Following the annual meeting of the fellows on Thursday afternoon, a conference on graduate training for surgery will be held in the Ball room at 3:00 p.m. Raising the standards of surgery has been a primary purpose of the American College of Surgeons since its organization. This will be accomplished through the present program of the College which has stimulated added interest in this subject on the part of all its fellows and a large number of approved hospitals. The Committee on Graduate Training for Surgery will present its report of activities for the year through its chairman, Dr. Dallas B. Phemister, of Chicago. Also, at this time, the list of hospitals approved for graduate training for surgery in the United States and Canada will be announced. Leaders in the field of graduate medical education will present and discuss at length the various phases and problems of organization and conduct of graduate training for surgery. This session should be of vital interest to the entire fellowship of the College and many practical suggestions will be offered for developing the needed systematic supervision, preceptorship, and guided instruction for young surgeons.

HOSPITAL CONFERENCES

The twenty first annual Hospital Standardization Conference will open the Clinical Congress with a session in the Rose Garden at the Bellevue Stratford Hotel on Monday morning at 10 o'clock. Official announcement of the approved list of hospitals for 1939 will be made at this session.

On Monday afternoon, and on Tuesday, Wednesday and Thursday, both morning and afternoon, an interesting program of papers, round table conferences and practical demonstrations, all dealing with various problems related to efficiency in the hospital, will be presented. On Wednesday and Thursday afternoons, at certain local hospitals, demonstrations in administrative and technical procedures will be conducted which will be of great interest to the hospital visitors.

At the hospital conference on Tuesday afternoon there will be an administrative panel round table discussion in which an effort will be made to cover as many aspects of hospital administration as possible with particular emphasis on maintenance of high professional standards, current economic problems and trends, and other timely subjects.

A special feature of the hospital conference will be a meeting of hospital executives on Tuesday evening, when the program will deal with the future of the voluntary hospital training of hospital administrators etc.

At a joint session with the Association of Medical Record Librarians of North America on Wednesday morning the subject of medical records will be considered from the standpoints of the various peculiarities of medicine and surgery.

There will be ample opportunity during the Congress for the visitors to inspect the hospitals in Philadelphia and vicinity.

HEADQUARTERS—TECHNICAL EXHIBITION

Headquarters for the Congress will be established at the Bellevue Stratford Hotel where there are unusual facilities for accommodating the Congress. The Grand Ballroom, Garden, Clover and Red rooms and other large rooms on the first and second floors and the roof have been reserved for scientific exhibits and conferences, registration, clinic ticket bureaus, bulletin board, executive offices, etc. Thus the activities of the Congress will be centralized under one roof.

The technical exhibition will be located in the Ballroom and adjacent rooms on the second floor. The registration and clinic ticket bureaus together with the registration desk will be centrally located on that floor. The bulletin boards on which the daily clinical programs will be posted each afternoon will be distributed through the exhibit rooms. Leading manufacturers of surgical instruments and supplies, x-ray equipment, operating room lights, hospital apparatus of all kinds, ligatures, dressings, pharmaceuticals and publishers of medical books will be represented in the exhibition.

ADVANCE REGISTRATION

The hospitals and medical schools of the Philadelphia area afford accommodations for large numbers of visiting surgeons but to insure against overcrowding attendance at the Congress will be limited to the number that can be comfortably accommodated at the clinics. The limit of attendance will be based upon the results of a survey of the operating rooms and laboratories of the hospitals and medical schools to determine their capacity for visitors. It is expected therefore that

those surgeons who wish to attend the Congress will register in advance. A registration fee will be required in order to provide funds with which to meet the expenses of the Congress. A formal receipt will be issued to each surgeon registering in advance which is to be exchanged for a general admission card upon his registration at headquarters during the Congress. This card which is not transferable must be presented in order to secure clinic tickets and admission to scientific sessions.

A resolution adopted by the Board of Regents provides that the registration fee for fellows and endorsed junior candidates shall be \$2.00 that no fee for the 1939 Congress shall be required of initiates (class of 1939) that the fee for non-fellows attending as invited guests of the College will be \$10.00.

As in previous years admission to clinics and demonstrations at the hospitals will be controlled by means of clinic tickets which plan provides an efficient means for the distribution of visiting surgeons at the various clinics and assures against overcrowding. The number of tickets issued for any clinic will be limited to the capacity of the room in which the presentation is held.

PHILADELPHIA HOTELS AND THEIR RATES

In addition to the headquarters hotel the Bellevue Stratford there are many first-class hotels within a short walking distance providing ample hotel facilities at reasonable rates. It is suggested that reservation of hotel accommodations be made at an early date at the following hotels which are recommended by the committee.

	Maximum rate with bath per day	
Adelphi, 13th and Chestnut Sts.	\$1.50	\$2.50
Barclay, Rittenhouse Square E.	4.50	5.00
Bellevue Stratford, Broad and Walnut St.	5.50	5.50
Benjamin Franklin, 9th and Chestnut St.	3.50	5.50
Colonial, 11th and Spruce Sts.	2.50	3.50
Drake, 1212 Spruce St.	4.00	6.00
Majestic, Broad St. and Girard Ave.	2.50	4.00
Philadelphian, 39th and Chestnut Sts.	2.50	4.40
Ritz Carlton, Broad and Walnut Sts.	3.50	6.00
Robert Morris, 17th and Arch Sts.	2.50	3.50
Spruce, 17th and Spruce Sts.	1.50	2.50
St. James, 13th and Walnut Sts.	2.50	4.50
Sylvania, Juniper and Locust Sts.	3.00	5.00
Walton, Broad and Locust Sts.	2.50	4.00
Warwick, 11th and Locust Sts.	4.50	7.00
Wellington, 19th and Walnut St.	4.00	6.00



F. D. S. Thoms. Engraver

Engraving by C. T. M. P.

Sir Henry Hallford, Bart.
1766 1844

SURGERY

GYNECOLOGY AND OBSTETRICS

An International Magazine, Published Monthly

VOLUME 69

AUGUST, 1939

NUMBER 2

EXPERIMENTAL PRODUCTION AND SPECIFIC TREATMENT OF GALL-BLADDER DISEASE

GUY M. NELSON, M.D., and MARTIN E. REHBUSS, M.D.
Philadelphia, Pennsylvania

EXPERIMENTAL studies on gall-bladder disease have evolved along three lines of approach: stasis, metabolic disturbances, and infection. Some observers maintain that stasis is a provocative cause and that metabolic disturbances underlie the problem of cholelithiasis. However, to explain infectious gall bladder disease and the two previous approaches demands the presence of an exciting factor. To day, many clinicians are prone to consider various forms of bacteria to be that exciting factor. The literature is full of references on the subject (3). Judd, Rosenow, Blacklock, Branch, Brown, Burden, Drennan, Friesleben, Taylor and Whitby, Illingworth, Magner and Hutcheson, Moynihan, Williams and McLachlan, Wilkie, Huntmuller (2), Gundermann (1), and many others have emphasized this association.

It is apparent from the literature that various workers obtained divergent percentage results in their bacterial studies on gall bladders removed at operation. In a former communication (3) we have considered this in detail. It is striking to note how the sum total falls into certain groups of organisms. These are the streptococcus, staphylococcus, colon

typhoid, and certain anaerobic groups. When more carefully considered these groups might well be further divided according to those causing acute infectious diseases, to those found in the foci of the head, and to those found in the lower intestines.

In the earlier studies on this subject an attempt was made to produce gall bladder disease by the intravenous injection of relatively massive amounts of live bacteria in laboratory animals. Too often such methods defeated the purpose of the investigation and resulted in deaths or acute lesions, neither of which resembled the chronic disease found in man. Gradually we learned to give smaller amounts and in January, 1935, (3) reported observations on a series of bacteria derived from various sources and resembling those reported in the literature which were found in culturing the gall bladders removed by surgeons. It is apparent from Table I that chronic cholecystitis has been reproduced in laboratory animals following the introduction of strains of some types reported as possible causative agents. At present we have used 105 antigens and nearly 1,500 animals.

For the past 2½ years our methods have been revised. We have chosen the Flemish giant rabbit. They are placed in individual cages, numbers tattooed on the ear, their tem-

From the Frankford Foundation for Medical Research Philadelphia

perature, weight, physical condition noted twice a week, or more often if sick. Their appetite noted daily and special individual examinations done and recorded every 2 weeks. In this way a case report similar to a case history is compiled. Gradually one becomes familiar with the differences between a sick and well rabbit competent to judge joints and the like. The amount of bacteria injected has been decreased to 0.02 cubic centimeter and 0.03 cubic centimeter of an 18 to 24 hour broth culture. Such injections are given once or twice a week over a 3 to 6 months period or less if the rabbit becomes ill. We watch the sick animals every 6 hours in order that postmortem examinations and notes may be made efficiently. Occasionally a very sick rabbit is killed to prevent postmortem changes when death seems imminent. We have chosen to use one organism, a non-hemolytic streptococcus obtained from a stool culture because in our earlier work gall bladder disease occurred in 20 per cent of the animals following its introduction. We have attempted to simulate the condition as it may exist in the human subject who has frequent minor infections by giving small repeated intravenous injections. We realize that it is almost impossible to duplicate focal infection as it exists in man.

In this study now to be reported, notice the marked difference following the change in our methods (Table II). The number of injections given varied from 1 to 31, the average

being 16.3 per rabbit. The incidence of gall bladder disease arose from approximately 20 to 50 per cent. The smaller percentage of recovered cultures would logically follow the production of a more chronic lesion.

It is striking to note the incidence of disease in other organs especially the kidneys and joints. We have seen practically every organ or system affected at one time or another—varying from paralysis with spastic vegetative endocarditis, gastric ulcer, lung abscess to infected nodes. This seems all the more significant when one considers how seldom a case of clinical cholecystitis is unaccompanied by other lesions. The accompanying photomicrographs (Figures 1, 2, 3, 4, 5) illustrate the various forms of chronic cholecystitis as produced.

However, there was no constant histological picture. Usually the muscle coat became thicker but any or all coats may be involved. Leucocytic infiltration of varying degrees may affect all or any coat. The epithelium may be normal, desquamated or eroded. Pericholecystitis, empyema, perforation and gall stones occurred occasionally.

The question then arose that perhaps some of these lesions might arise from bacterial emboli in the smaller arterioles and might not be the result of live bacteria *per se*. We selected two groups, each consisting of 10 healthy rabbits and gave massive intravenous injections every other day for a period of 3 months. One group received an autogenous vaccine, the other an autogenous filtrate made from the non-hemolytic streptococcus being investigated. An average of 5,000 million bacterial bodies were given to each rabbit in the first group. At autopsy one rabbit had a sterile caseous mass in the lower right lung and moderate pitting of the kidney surface. The other abnormal animal had marked pitting of the kidney surface. Its cut surface was

TABLE I—VARIOUS BACTERIA USED IN ATTEMPT TO PRODUCE EXPERIMENTAL GALL BLADDER DISEASE

Organism	Trans used	Rabbits used	Diseased gall bladders	Positive bile cultures
<i>Bacillus coli</i>	8		4	6
<i>Bacillus pyocyaneus</i>				
<i>Bacillus mucosus pusillus</i>			0	0
<i>Streptococcus hemolyticus</i>				()
<i>Streptococcus non-hemolyticus</i>	5	7	4	9 ()
<i>Streptococcus viridans</i>	3	7		0 ()
<i>Staphylococcus aureus</i>	4			3 ()
Totals	44	29	5	

With some slightly different characteristic from original.

TABLE II—AUTOPSY FINDINGS STREPTOCOCCUS NON-HEMOLYTICUS INJECTIONS

	Number	Per cent
Rabbits used	166	
Diseased gall bladders	84	50.6
Organisms recovered from bile	25	15.0
Diseased kidneys	58	
Diseased joints	110	

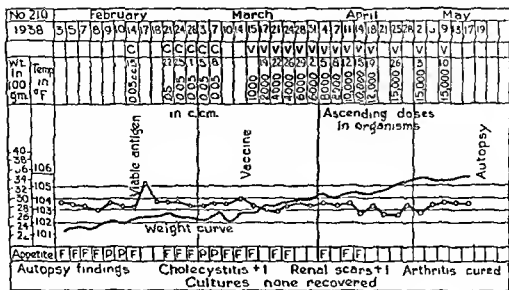


Chart 1 Method of keeping rabbit's record

streaked with white lines, the cortex definitely narrowed. In the other group each animal received 4 \times cubic centimeters of 1:50 dilution of filtrate. The only abnormal finding was moderate pitting of the kidney surface in one instance. In none was an abnormal gall bladder found. Cultures from bile and kidneys were negative. Therefore, we felt that such diseased processes described must be ascribed in a large measure to the live bacteria.

In a former report (4) on immunological studies with this organism we showed that joint lesions and to a less extent gall bladder disease were lessened in those animals which received a small series of vaccine and filtrate injections prior to inoculation. We wondered whether treatment of sick animals with such preparations would be of value. The attempt to determine whether gall bladder disease was present prior to treatment was made by separate roentgenographic study (R M Smith and G M Nelson). There was found to be a 33 per cent error in such diagnoses and, since the incidence of its production had exceeded 50 per cent, we segregated the sick animals into groups of threes: control, vaccine, and filtrate. Such a selection depended upon clinical observations, the number of bacterial injections, the temperature variations, weight loss, and joint disease. An attempt was made to give preferences to the control group and to select three treated alike and those sick alike from the clinical viewpoint (Table III).

The care of all groups as regards feeding and observations was identical. The vaccine group received at planned intervals and for an elective duration intradermal doses of the autogenous vaccine. Likewise the filtrate group received 1:50 and 1:100 dilutions of the autogenous filtrate. Autopsy examinations of all animals were made at the same date unless death or extreme illness prevented. In Table III we have compiled the findings of the three groups so treated according to self-evident gross pathological findings from the autopsy records. To avoid error we have included only the kidney, joint, gall bladder, and cultural findings since they are so easy to detect. Any questionable lesion is not included. That preference was given to the control group is suggested when one notes that 7 of the 59 were found to be grossly normal at necropsy. When one deducts the number of normals from the total number, it is surprising to see how closely the number of diseased animals parallel each other in the three groups.

The incidence of gall bladder disease is practically the same in the control and filtrate groups and less in the vaccine group. This might be explained as a result of the treatment received. Certainly one sees gross evidence of disease in many with a return of function if the appearance of the gall-bladder bile be a criterion. The smaller incidence of positive cultures in the bile would suggest such a conclusion. However, the most striking indi-

TABLE III—COMBINED TREATMENT GROUPS—AUTOPSY FINDINGS

	Control		Vaccine		Filtrate	
	N	C	N	C	N	C
Number of rabbits	59		50		57	
Number normal	7		2		2	
Gall bladder disease present	31	52.5	19	38	32	56
Cultures from bile	11	35.5	4	21	9	25
Kidney disease present	22		17		20	
Cultures from kidneys and urine	5		1		5	
Joint disease present	35		16		39	
Cultures from joints	5		2		7	
Cultures from any organ	17	29	1	10	16	28

TABLE IV—AUTOPSY FINDINGS IN ANIMALS TREATED FOR PLANNED PERIOD

	Control		Vaccine		Filtrate	
	N	C	N	C	N	C
Number of rabbits	43		44		41	
Number diseased	3		42		39	
Gall bladder disease present	25	58	19	43	21	63
Cultures from bile	1	24	3	43	6	23
Kidney disease present	10		14		10	
Cultures from kidney	1		0		1	
Joint disease present	20		14		30	
Cultures from joints	2		1		3	
Cultures from any organ	9	20	4	9	4	19

cation of the possible effect of treatment is noted in the sum total of animals from which positive cultures of the original non hemolytic streptococcus was recovered at autopsy. In the vaccine group only 10 per cent were recovered whereas from the control group 29 per cent and from the filtrate group 28 per cent.

To make the analysis more complete the rabbits which died or were killed during the treatment period were studied further. The death incidence in the vaccine group (6 rabbits) was markedly decreased while in the two other groups it was approximately equal (16 controls 17 filtrates). Not one of those treated with vaccine had gall bladder disease and only one positive bile culture was obtained this being in a case of septicemia. In the control group gall bladder disease was present in 6 of the 16 deaths and in the filtrate group in 6 of the 17, with positive bile cultures in 5 of the control group and in 3 of the filtrate group. The incidence of total positive cultures from all organs in the vaccine group was 33 per cent (2 of 6), while in the other groups it was

TABLE V—AVERAGE WEIGHT IN GRAMS AND TEMPERATURE READINGS, FAHRENHEIT OF ANIMALS LIVING TO TERM

	Control		Vaccine		Filtrate	
	Weight	Temp	Weight	Temp	Weight	Temp
At outset	2954	103.3	2098	103.4	2909	103.1
1 month	3075	103.4	3095	103.4	3238	103.2
2 months	3925	103.3	3312	103.5	3531	103.3
Autopsy	3461	103.3	3540	103.3	3649	103.2

TABLE VI—ANIMALS WITH JOINT DISEASE LIVING TO TERM

	Control		Vaccine		Filtrate	
	N	C	N	C	N	C
Clinical findings—						
Rabbits	31		36		28	
Improved	20	65	27	75	23	82
Unimproved	11		9		5	
Autopsy findings—						
Cure	8	26	9	25	7	25
Improved	19	61	25	69	18	64
Furulent	4	13	2	6	3	11

approximately 50 per cent (8 of 16 controls and 8 of 17 filtrates).

A further analysis of the deaths in this group of rabbits killed or dying during treatment was made to determine the time interval between treatment and death. Four of the control group lived less than 1 month with positive bile cultures in 1, 3 lived for a period of 1 to 2 months with no positive bile cultures, 3 lived 2 to 3 months with 1 positive bile culture, 6 lived 3 to 6 months, with 3 positive bile cultures. Of the vaccine group 2 lived less than 1 month with no positive bile cultures, 2 lived 1 to 2 months with 1 positive bile culture, 1 lived 2 to 3 months with no positive bile culture, and 1 lived 3 to 6 months with no positive bile culture. Of the filtrate group 7 lived less than a month with 3 positive bile cultures, 2 lived 1 to 2 months, 4 lived 2 to 3 months and 4 lived 3 to 6 months with no positive bile culture. In other words 9 of the controls and 8 of the filtrate group lived longer than 2 months whereas there were only 2 deaths in the vaccine group. This would suggest that treatment might have decreased the death rate in this group.

But to be more critical, in Table IV we have excluded all deaths, and the same trend was present.



Fig 1

Fig 2

Fig 3

Fig 1 Section from normal gall bladder of rabbit to illustrate various coats and thicknesses $\times 60$

Fig 2 Section taken from a markedly fibrous and edematous gall bladder wall showing atrophy of the

mucosa and desquamation of the epithelium $\times 60$

Fig 3 A marked inflammatory reaction involving all coats. Note the extensive leucocytic infiltration of the mucosa $\times 60$

The vaccine group had a lower percentage of gall bladder lesions, a decrease in the relative positive bile and total cultures from all organs, whereas the other two groups still paralleled each other.

In Table V is to be found the total average weight and temperature readings of each group. The weight curve of the controls increased up to the second month and then decreased. The vaccine group and the filtrate group, but to a less degree, consistently increased. The temperature curves are similar.

In Table VI the composite findings of clinical and autopsy observations on joints are shown. There was very little difference when the autopsy findings were compared. These figures would be changed materially if one were to consider those dying during the course of treatment inasmuch as the mortality rate was greater in the control and filtrate groups.

We realized that the amount of vaccine and filtrate to administer was unknown. Soon we began to alternate groups under treatment giving 2,000 bacterial bodies and 0.05 cubic



Fig 4 left A moderate thickening and fibrosis of the wall and a leucocytic infiltration of all coats $\times 75$

Fig 5 Slight thickening of the wall with edema. Note

a slight mononuclear leucocytic infiltration of submucosa, atrophy of mucosa and desquamation of the epithelium $\times 75$

TABLE VII—TREATMENT ANALYSIS—SMALL
DOSES—AUTOPSY FINDINGS

	Control	Vaccine	Filtrate
Rabbits	22	23	27
Normal	1	0	1
Gall bladder disease present	15	9	14
Positive bile cultures	1	1	4
Kidney disease present	9	10	11
Cultures from kidney	1	1	4
Joint disease present	17	17	17
Joint cultures positive	3	2	6
Total cultures from any organ	5	3	11
Died or killed	2	4	12
Gall bladder disease present	0	0	4
Positive bile cultures	0	0	2

centimeter of 1:100 dilution of filtrate twice a week to one group and ascending doses twice a week to the other until 15,000 bacterial bodies and 0.3 cubic centimeter of the filtrate had been reached. In Table VII note that when small doses were given the filtrate group had far more deaths, more positive bile and total cultures. The 2 other groups fairly well paralleled each other except that the incidence of gall bladder disease was definitely less in the vaccine group.

In Table VIII note a smaller incidence of gall bladder disease in the vaccine group, a smaller percentage of recoveries of organisms both from the bile and all organs than in the other groups. The death rate remains low. The filtrate group has fewer organisms recovered and a definitely lower death rate than in the previous tables. It almost parallels the vaccine group and might suggest that the small doses were inadequate.

We deliberately varied the duration of treatment for the sake of comparison. In Table IX are those treated for 2 to 3 months. In comparing the vaccine with the control

TABLE VIII—TREATMENT ANALYSIS—LARGE
DOSES—AUTOPSY FINDINGS

	Control	Vaccine	Filtrate
Rabbits	22	21	21
Normal	2	2	1
Gall bladder disease present	11	9	13
Positive bile cultures	6	2	3
Kidney disease present	8	6	5
Positive cultures from kidney	2	0	1
Joint disease present	13	13	16
Positive cultures from joint	1	0	0
Total cultures from any organ	6	2	3
Killed or died	1	2	1
Gall bladder disease present	3	0	1
Positive bile cultures	2	1	0

group the incidence of gall bladder disease was materially less. The death rate and total number of organisms recovered from all organs was less. The filtrate group was relatively similar to the control except for definite increase in organisms recovered from all organs.

In Table X are those treated for 3 to 4 months. In comparing the vaccine and control groups notice in those treated with vaccine a definite decrease in the incidence of all disease. In no instance was the non-hemolytic streptococcus recovered from the vaccine group. In comparing the filtrate with the control group there was very little difference.

Table XI includes those treated for a period of 4 to 6 months. The vaccine and filtrate groups paralleled in a general way the control group except for a definite decrease in the organisms obtained from the bile and all organs at autopsy. A comparison of these treatment periods would make one think the longer treatment intervals are the best.

During the course of treatment 72 rabbits were fed nothing but rolled oats for a period of $\frac{1}{2}$ months. This diet was inadequate in

TABLE IX—TREATMENT ANALYSIS—2 TO 3
MONTHS—AUTOPSY FINDINGS

	Control	Vaccine	Filtrate
Rabbits	25	19	30
Normal	3	1	2
Gall bladder disease present	16	7	16
Bile cultures positive	4	3	6
Kidney disease present	5	1	9
Positive cultures from kidney	1	1	5
Joint disease present	1	13	20
Positive cultures from joints	1	1	6
Total cultures from any organ	6	4	13
Died or killed	5	5	12
Gall bladder disease present	3	1	4
Positive bile cultures	1	0	3

TABLE X—TREATMENT ANALYSIS—3 TO 4
MONTHS—AUTOPSY FINDINGS

	Control	Vaccine	Filtrate
Rabbits	10	10	13
Normal	0	2	0
Gall bladder disease present	7	4	10
Bile cultures positive	4	0	3
Kidney disease present	5	3	5
Kidney cultures positive	1	0	0
Joint disease present	9	4	9
Joint cultures positive	3	0	1
Total cultures from any organ	4	0	3
Died or killed	3	0	3
Gall bladder disease present	2	0	1
Positive bile cultures	2	0	0

TABLE XI—TREATMENT ANALYSIS—4 TO 6 MONTHS—AUTOPSY FINDINGS

	Control	Vaccine	Filtrate
Rabbits	24	21	14
Normal	3	0	1
Gall bladder disease present	10	9	6
Bile cultures positive	5	1	0
Kidney disease present	10	7	6
Kidney cultures positive	1	0	0
Joint disease present	10	10	10
Joint cultures positive	1	1	0
Total cultures from any organ	7	2	0
Died or killed	1	0	2
Gall bladder disease present	0	0	1
Positive bile cultures	0	0	0

certain vitamins. Following this period a preparation was fed containing vitamins A, B₁, D, E, and G. In Table XII you will note the uniform loss in weight in the 10 day period preceding its administration, as well as the uniform gain in all groups after the administration of this vitamin containing food.

In Table XIII is the record of the autopsy findings. The incidence of gall-bladder disease was considerably higher in all groups when compared to the combined groups (Table XI), whereas there was a lowering of the percentage of organisms recovered from the bile in all groups except the filtrate. It is also quite striking to note that only 3 rabbits in our entire vaccine group had gall bladder disease at autopsy which did not fall into this group. There was no material increase in the incidence of kidney and joint disease in any group when compared to the total groups studied, and there was practically no difference in the percentage of positive organisms found in all organs as compared with the findings in the composite groups. One wonders whether a certain vitamin or vitamins, plus vaccine therapy

TABLE XII—AVERAGE WEIGHT PER RABBIT BEFORE AND AFTER VITAMIN FEEDINGS

	Control	Vaccine	Filtrate
January 10	2677	2762	2820
January 20	2609	2687	2734
January 31	2642	2919	3041
Total loss in 10 days before	68	75	76
Total gain in 11 days after	333	292	207

might not be the responsible factors in the improvements noted in the vaccine group.

SUMMARY

This study deals with one organism, a non hemolytic streptococcus. We realize that a

TABLE XIII—AVITAMINOSIS GROUP—AUTOPSY FINDINGS

	Control	1 cc vaccine	2 cc vaccine	Filtrate	Per cent
Rabbits	24	25	23	2	
Normal	2	2	2	2	
Gall bladder disease present	17	70	16	64	19 83
Bile cultures positive	3	18	2	13	6 32
Kidney disease present	11	9	7	7	
Kidney cultures positive	1	1	4	4	
Joint disease present	16	67	16	64	14 60
Joint cultures positive	1	1	1	1	
Total cultures from any organ	3	20	2	8	7 30

larger series is necessary before definite conclusions can be drawn, but it is hoped that in the interim, others will be sufficiently interested to parallel this tedious and time consuming investigation. From the data presented the following inferences may be temporarily deduced:

1. Chronic cholecystitis similar to the human forms has been produced. These lesions have been associated frequently with multiple lesions reminding us of the frequency in which one sees associated lesions in the clinical varieties of human cholecystitis.

2. Those animals treated with large doses of vaccine over a period of 3 months or more had a definitely smaller percentage of gross gall bladder lesions and there was a definite decrease in the incidence of the recovery of the organism at autopsy.

3. Those animals treated with filtrate by and large were quite similar to the untreated group. There is some evidence to suggest that our dosage may have been too small.

4. Vitamins were necessary in all groups to maintain weight. In addition there is reason to believe that an adequate vitamin content in the diet combined with the administration of vaccine is necessary to control successfully this form of experimental cholecystitis.

REFERENCES

1. CUNDERMANN, W. Cholecystitis und cholangitis, staphylococcus cholecystitis coliholecystitis. Mitt. d. Grenzgeb. d. Med. u. Chir. 1924 37 381.
2. HUNTEMULLER, O. Die Bakteriologie der Gallenwege. Muenchen med. Wchnschr. 1928 72 2140.
3. REHFUSS and NELSON. The problem of infection in gall bladder disease, etc. Am. J. Digestive Diseases & Nutrition 1935 1 764.
4. REHFUSS and NELSON. Am. J. Digestive Diseases & Nutrition 1935 2 593.

INTESTINAL POLYPS PATHOGENESIS AND RELATION TO MALIGNANCY

ROBERT J. COLFFY, M.D. and J. ARNOLD BARGEN, M.D., Rochester, Minnesota

NUMEROUS classifications of polyps of the large intestine based on the etiology, pathology and clinical features have been attempted. Multiple polyps are frequently encountered in such an inflammatory disease as ulcerative colitis. The polyps of multiple adenomatosis of the large intestine have been thought to be different in origin and nature from those associated with this inflammatory disease. This is a comparative clinicopathological study of polyps occurring under these two conditions.

REVIEW OF LITERATURE

The earliest report of intestinal polyposis was made by Menzel in 1721 and during the following 150 years, Wagner, Rokitsky, Lebert and Virchow described polyps of the intestine. Woodward in 1881 emphasized that small polyps form during the phase of healing of chronic ulcerative colitis whereas Cripps in 1882 distinguished the condition which he called disseminated polyposis and noted an hereditary basis.

The results of earlier investigations suggested that intestinal polyps may be dissimilar both etiologically and pathologically and undoubtedly accounted for the innumerable classifications that were later suggested. Those of Erdmann and Morris and Susman are based on etiological and clinical considerations whereas Schmieden and Westhues, Wesson and Bargen and Lockhart Mummery have proposed that polyps be classified on the basis of their pathological characteristics. Three basic concepts concerning the etiology of multiple adenoma of the large bowel exist: first, the hypothesis of Virchow that a hyperplastic response to inflammation produces the polyps; second, the

opinion of Ribbert that the tumors originate from misplaced embryonic rests in the wall of the bowel, and finally, that chronic irritation in the presence of a congenital predisposition is necessary, as suggested by Verse Genkin and Dmitruk. Hoelzel and Da Costa have been successful in producing polyps experimentally in animals.

A hereditary disposition to multiple adenomatosis of the intestine has been noted repeatedly and Lockhart Mummery believes that the condition is transmitted as a mendelian dominant characteristic. Hullsiek found evidence of a hereditary disposition in 11 per cent of 127 cases, whereas Mayo and Wakefield in a review of 19 cases found that 5 of the 38 parents had carcinoma of the colon. The congenital occurrence of the disease has never been substantiated by the demonstration of polyps at birth, although McKenney reported a case of a patient aged 2 years and Kennedy and Weber found polyps in a child aged 2½ years.

Lockhart Mummery and Dukes have stated that malignant changes always occur in cases of true multiple adenomatosis, whereas Soper found the incidence of carcinoma to be 43 per cent in such cases. McKenney found malignant changes in a third of his cases, whereas Felsen failed to observe this complication as frequently.

There has been general agreement concerning the pathology of multiple polyposis and the term 'multiple adenomatosis' as suggested by Lockhart Mummery seems more suitable inasmuch as it describes the pathological nature of the polyps. However, there is much disagreement concerning the pathogenesis of these tumors. The occurrence of tiny mammillations throughout the intestinal mucosa and also diffuse mucosal hyperplasia have been observed frequently. The association of enlarged lymph follicles and lymphocytic infiltration with the earliest manifesta-

Abridgment of thesis submitted by Dr. Colffy to the Faculty of the Graduate School of the University of Minnesota in part as fulfillment of the requirements for the degree of M.S. Medical Work done on the Intestinal Service, St. Mary's Hospital, From The Mayo Foundation and the Division of Medicine, The Mayo Clinic.

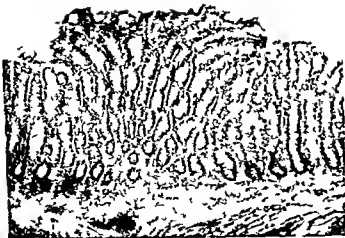


Fig. 1 Localized region showing lengthening of the glands and benign hyperplasia $\times 45$

tions of the polyps has been observed by Schmieden and Westhues, Fansler, Saint, and Feyrter

The occurrence of polyps as the result of gross inflammation of the large intestine has been accepted generally as an entity distinct from multiple polyposis or adenomatosis. Barga and Comfort found that polyps developed in 10 per cent of their cases of chronic ulcerative colitis and they emphasized that the polyps occur with the greatest frequency at the site of the most severe inflammation. Saint, on the other hand, was of the opinion that polyps were more prone to develop in the region of a mild, less destructive inflammatory process. Dukes, and Hewitt and Howard claimed that the polyps develop at the points at which the blood vessels pierce the wall of the bowel, an observation that Rankin failed to substantiate.

Barga and Comfort demonstrated that the polyps in cases of chronic ulcerative colitis represent isolated regions of mucous membrane or granulation tissue which result from widespread sloughing of the mucous membrane of the colon. The pathological nature of these tumors has been studied by Brust and Barga, who found that they were usually composed of granulation tissue and, in some instances, of mucosal remnants in which inflammatory hyperplasia was conspicuous. They added that true adenomas are relatively rare. Horgan, Wheeler, Buie, and Hurst have noted the development of true adenoma in



Fig. 2 Adenomatous change in several isolated glands, cellular infiltration is conspicuous $\times 115$

cases of chronic ulcerative colitis, whereas Felsen failed to identify adenoma in cases of bacillary dysentery in which polyps developed.

The importance of carcinoma as a complication of chronic ulcerative colitis has been stressed by one of us and malignant change has been noted in 2.5 per cent of a large series of cases. The hypothesis that a transition of inflammatory polyps to adenomatous polyps occurs, and that subsequently carcinoma develops has been offered. In a series of cases of chronic ulcerative colitis in which carcinoma developed, polyps were found in 60 per cent. Ewing, and Schmieden and Westhues have failed to observe any instance of malignant change in cases of chronic ulcerative colitis.

METHODS

A comparative clinicopathological study of the two types of polyps was carried out.

Multiple adenomatosis. Those cases of multiple polyposis of the colon, in which a history of antecedent inflammation of the colon was lacking and which were encountered at the



Fig. 3 a left. Hyperplastic lymph follicle which has ruptured through the muscularis mucosa and has caused protrusion of the overlying mucosa $\times 3$ b Hyperplastic



lymph follicle associated with adenomatous change in several of the gland which were in the overlying mucosa $\times 40$

clinic during the years 1930 to 1934 inclusive were selected. A survey of salient clinical features was made and the available pathological specimens were studied in regard to their pathogenesis and their pathological nature.

Chronic ulcerative colitis with polyposis. Cases were chosen from two periods, namely 1913 to 1923 inclusive and 1932 to 1934 inclusive in order to determine the influence if any of more recent modes of treatment of chronic ulcerative colitis on the incidence of polyposis. Significant clinical features of

these cases were reviewed and the available pathological material was studied grossly and microscopically.

RESULTS

Multiple adenomatosis. Of the 29 patients 69 per cent were males. Fifty two per cent were in the first 2 decades of life and 17 per cent were in the third decade. The youngest was 9 years and the oldest 71 years old.



Fig. 4 Chronic ulcerative colitis. polypoid tufts of mucosa with complete destruction of the mucosa in the adjacent region



Fig. 5 Chronic ulcerative colitis. polyps in which their bridge like structure is demonstrated. Bridges of mucosa and granulation tissue are often formed.

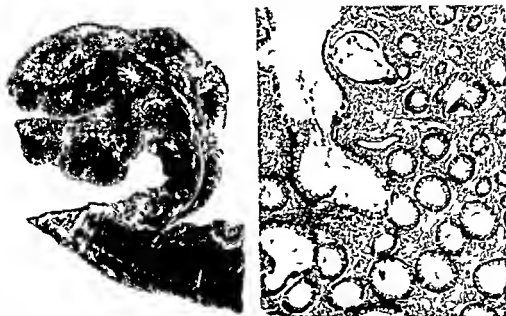


Fig 6 a left Chronic ulcerative colitis large pedunculated pseudo adenomatous polyp $\times 36$ b Section of polyp shown in Figure 6 a in which benign regeneration is evident and large cystic glands are present $\times 47$

In 34.5 per cent of the cases, presumptive evidence of a familial disposition, as indicated by a history of multiple adenomatosis or carcinoma of the colon among parents or siblings, was established. One family history deserves special mention in that both parents were found at necropsy to have multiple adenomatosis of the colon and 3 siblings died as the result of carcinoma of the large bowel, where-

as one sibling died of sarcoma of the small intestine.

In 62 per cent of the cases, the passage of blood in the stools was the chief complaint, whereas diarrhea without blood, vague abdominal pain and the protrusion of rectal polyps were noted in that order of frequency among the remainder. In 69 per cent of the cases, the polyps were distributed throughout



Fig 7 a left Chronic ulcerative colitis polyps b section of one of the polyps in a case of chronic ulcerative colitis revealing adenomatous proliferation of the glands $\times 56$

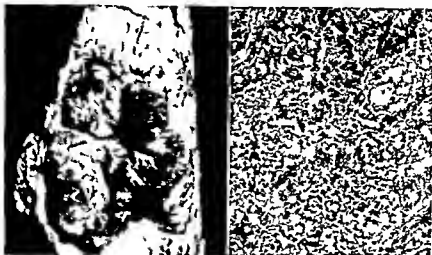


Fig. 8 a left Malignant polyp of the sigmoid occurring as a complication of chronic ulcerative colitis with several smaller polyps immediately proximal to the carcinoma b section of malignant polyp which is adenocarcinoma grade 3 $\times 37$

the entire large bowel. The right side of the colon escaped involvement more frequently than the left and the rectum was free of polyps in only 2 instances. Of interest was

the observation that the entire large bowel was involved in all the cases in which a familial disposition was evident. In 2 instances the lining of the stomach and entire intestinal tract was covered with polyps and in another patient the stomach in addition to the colon was the seat of polyposis. A solitary duodenal adenoma was found in 2 patients.

Polyps of every conceivable variety were observed ranging from tiny mammillations that escaped casual scrutiny to large pedunculated tumors. In some specimens countless polyps diffusely covered the surface of the opened bowel whereas in others discrete tumors were sparsely scattered throughout. A segmental involvement was occasionally noted. The adenomatous character of the polyps was a constant finding and our interest was centered chiefly in the identification of carcinomatous changes. In pathological material from 4 cases multiple carcinoma existed. The majority were grade 1 (Broders classification).

In order to study the pathogenesis of the polyps numerous histological preparations were made from regions in which the mucosa appeared to be normal or in which tiny mammillations were observed. The mucosa was invariably well formed and intact frequently exhibiting a wavy undulating appearance. Infiltration of the interstitial tissue with



Fig. 9 Section of polyp in which carcinoma (grade 1) is seen in an adenomatous polyp $\times 46$

lymphoid and plasma cells was a constant finding but in no instance was there evidence of severe destructive inflammation, as seen in cases of chronic ulcerative colitis. The muscular and serosal layers of the bowel appeared to be normal.

Localized benign hyperplasia of the glands was occasionally observed, and in some sections this appeared to be merely a lengthening of an isolated group of glands (Fig 1). Localized adenomatous hyperplasia was most conspicuous in sections from the grossly normal mucosa. Histological sections of the tiny excrescences were usually found to be composed of a cluster of adenomatous glands. Frequently, this adenomatous change appeared to involve several isolated glands and generally it was first observed in the tips of the glands (Fig 2). Carcinomatous changes were encountered twice in these tiny excrescences.

An observation of paramount interest in the study of the pathogenesis of the polyps was the invariable presence of hyperplastic lymph follicles in the submucosa (Fig 3) and less frequently in the mucosa. The germinal centers of these follicles were conspicuously enlarged and contained many mitotic figures. Not infrequently, a localized bulging of the mucosa over such an enlarged follicle occurred, and, furthermore adenomatous changes in these protruded areas were observed with striking regularity. The frequent presence of lymph follicles in the stalks of the well developed polyps might be interpreted as being a more advanced phase of this process.

Polyposis associated with chronic ulcerative colitis. Patients who had chronic ulcerative colitis and who registered at The Mayo Clinic during the period of 1913 to 1923 inclusive, will be considered under group A, whereas group B is comprised of those who entered the clinic during the period of 1932 to 1934 inclusive.

Polyps were found in 66 of 417 patients in group A (15.8 per cent). Of 400 patients in group B, polyps were demonstrated in 40 (10 per cent). In both groups the incidence of polyps was greatest in the third and fourth decades of life.

The inflammatory process had involved

the entire colon in the majority of cases. The frequency with which the wall of the bowel escaped involvement varied directly with the distance from the rectum and in both groups only 1 case was encountered in which the rectum was not involved. The severity of the chronic ulcerative colitis, as determined by the local and constitutional manifestations of the disease and by the proctoscopic and roentgenographic appearance of the bowel was graded in group A as severe in 47 per cent, moderate in 35 per cent, and mild in 18 per cent of the cases, whereas in group B 35 per cent were graded as moderate and 28 per cent as mild. The average duration of the symptoms of colitis was 6 years in group A and 5.7 years in group B. The shortest period of symptoms was 6 weeks and the longest was 34 years.

In group A the polyps were distributed throughout the entire large bowel in 16.6 per cent of the cases, whereas in 51.5 per cent they were limited to the rectum. Comparable distribution existed in group B. The polyps were found in largest numbers in the rectum and decreased in frequency in the more proximal segments of the large intestine.

In the earlier group the polyps were demonstrated by proctoscopic examination in 85 per cent of the cases, whereas roentgenographic study of the colon revealed their presence in only 10.6 per cent. They were found at postmortem examination in 26 per cent of the cases. In group B the polyps were seen proctoscopically in 90 per cent of the cases, whereas they were demonstrated roentgenologically in only 35 per cent of cases, and in only 10 per cent were they found at postmortem examination.

In many cases the cicatricial narrowing of the bowel that invariably occurred with chronic ulcerative colitis was sufficiently exaggerated in a localized segment to constitute a stricture. When such a lesion developed, polyps were constantly found in the adjacent mucosa, usually above the strictured point and, in some instances, this was the sole site of the polyps. In group A, strictures were found in 31.8 per cent of the cases, whereas in group B such areas of narrowing were found in 20 per cent.

Of the cases in group A 48.5 per cent were subjected to a major surgical operation, usually an ileostomy, with an immediate post operative mortality rate of 47 per cent. Of the medically treated patients, 53.5 per cent died within a period of 4 years. Only 6 (15 per cent) of the patients in group B were treated surgically, and of these 4 died after operation. The mortality rate associated with medical treatment in this series over a period of 4 years was only 11.5 per cent.

Macroscopically the polyps varied in size from a few millimeters to as much as 3 centimeters in diameter. In most of the specimens the polyps appeared as protruding tufts of mucosa in areas that were otherwise devoid of any mucous membrane (Fig. 4). These tags often formed bridges of mucosa and granulation tissue which were attached at both extremities to the wall of the bowel (Fig. 5). However occasionally the polyps had the appearance of exuberant outgrowths from the already diseased mucosa whereas in a few specimens a polypoid tumor highly suggestive of carcinoma was encountered. In all specimens the ulcerative process seemingly had damaged irreparably the wall of the bowel with great thickening and fibrosis of the submucous and muscular layers.

After examining numerous histological sections it was decided to classify the polyps in a manner that offered some prognostic significance. Consequently they were divided into 3 groups namely (1) pseudo adenomatous polyps (2) adenomatous polyps, and (3) carcinomatous polyps.

Included in the group of pseudo adenomatous polyps were structures ranging from small tags of granulation tissue in which there was a more or less complete absence of mucosa to large pedunculated polyps of several centimeters in diameter composed largely of hyperplastic glands (Fig. 6). However the important criterion in this classification was not the amount of glandular tissue in the polyps but was rather the cytological structure of the individual glands. Consequently these polyps often appeared adenomatous at first glance but, upon more detailed scrutiny, the glandular hyperplasia was recognized as a benign regenerative process as evidenced

by the orderly arrangement of the lining cells in which the normally staining nuclei were aligned along the basement membranes with an overlying layer of clear cytoplasm. The cells secreted mucus in normal or excessive amounts. Frequently large cystic glands were seen. In other words, some of the pseudo adenomatous polyps were very hyperplastic, but this hyperplasia was an orderly, functioning response to the underlying stimulus—inflammation. The use of the term "inflammatory" has been avoided in this classification inasmuch as evidence of inflammation was invariably conspicuous in all the polyps associated with chronic ulcerative colitis. The term "pseudo adenomatous" has been applied to this group in order to indicate that any evidence of a tendency toward neoplastic change was lacking. This group is analogous to the pseudopolyps as classified by Wesson and Barger.

The second group included all polyps in which any adenomatous hyperplasia was discovered. These ranged from small finger like projections of granulation tissue containing only a few glands to large pedunculated and sessile polyps. Usually they were of larger size and possessed a more exuberant character than the pseudo adenomatous polyps but exceptions to this were found. Adenomatous changes in the glands were manifested by an increase in the size, abnormally deep staining and malalignment of the nuclei, numerous mitotic figures, diminution in the amount of cytoplasm and diminution in the amount of mucus produced. These changes in some instances, were slight (Fig. 7) and were distinguished only with great difficulty from the more advanced types of pseudo adenomatous hyperplasia. On the other hand, advanced adenomatous hyperplasia constituted a fine distinction from carcinoma *in situ*. Adenomatous changes were occasionally confined to a few isolated glands in a polyp which was composed almost entirely of granulation tissue or of benign glandular elements. The cytological changes in these polyps constitute a definite type of dedifferentiation and anaplasia and represent an abnormal regenerative response. It is a matter of interesting conjecture as to whether these polyps would even

usually become carcinomatous if the individuals lived sufficiently long, but it seems obvious that the tendency toward malignant change in these is increased. These polyps are similar in cytological details to the adenomas associated with multiple polyposis and those designated as true polyps by Wesson and Bargen.

Carcinomatous polyps were usually of relatively large size, and they presented a dusky red, hemorrhagic appearance which immediately aroused a suspicion of their malignant nature (Fig 8). However, in several instances carcinoma *in situ* was discovered in small adenomatous polyps (Fig 9). This distinction between an advanced adenomatous change and carcinoma of low grade frequently was barely perceptible and was evidenced by more advanced dedifferentiation and anaplasia, and occasionally by invasion of the submucosa.

Pathological material from 32 of the cases was available, being secured at necropsy in 20 cases, by biopsy during proctoscopic examination in 8 cases, and as a surgical specimen in 4 cases. In 18 (56.2 per cent) of the cases, the polyps were classified as pseudo adenomatous. Adenomatous polyps were found in 7 (21.9 per cent) of the cases, the adenomatous changes being slight in 4 and severe in 3 instances. Carcinomatous changes were identified in 7 (21.9 per cent) of the cases, and 3 were grade 1, 1 was grade 2, whereas 2 were grade 3. In one specimen 2 polyps were carcinoma grade 1 and 2 others were grade 3. In 3 of these cases multiple carcinoma was found, whereas in 2 specimens other polyps showed adenomatous changes. Of the carcinomatous polyps 2 were papillary in structure. In 2 cases carcinoma *in situ* was discovered.

SUMMARY AND CONCLUSIONS

1 A comparative clinicopathological study of a group of cases of multiple adenomatosis and of polyposis, occurring in the course of chronic ulcerative colitis, revealed that these 2 conditions are extremely dissimilar both clinically and pathologically. Changes were apparent in the clinical course of the 2 conditions as well as in their histogenetic and pathological characteristics.

2 In the cases of multiple adenomatosis the onset of symptoms was insidious with rarely more trouble than that caused by passing an increasing amount of blood by rectum. Rarely, except in late stages of the condition, was the individual ill in any clinical sense. In the cases of polyposis associated with chronic ulcerative colitis the onset of symptoms was likely to be insidious and the illness itself was much more likely to be of a severe fulminating type. If this was not apparent at the onset such a condition prevailed at some time during the course of the disease and before polyposis became the important difficulty.

3 A hereditary disposition existed in 34.5 per cent of the cases of multiple adenomatosis. This entity is essentially a disease of youth, as approximately two thirds of the cases in this study occurred during the first 3 decades of life. Multiple adenomatosis often developed in the later decades of life and this type is indistinguishable pathologically and clinically from that occurring in adolescence.

4 The individual lesion consisted of a primary epithelial change attended by minimal evidence of inflammation. Hypertrophic lymph follicles seemed to play a rôle in the pathogenesis of these polyps.

5 The condition is characterized by the occurrence of myriads of true adenomatous polyps in which carcinomatous changes were found in 62.5 per cent of the cases, and in 25 per cent there were multiple carcinomas.

6 Studies of the pathogenesis of the multiple adenomas revealed that multiple small foci of adenomatous proliferation develop in a usually hyperplastic mucosa. Consequently, multiple adenomatosis is a disease of the entire mucosa, and therapy which eradicates only the existent polyps fails to cure the condition. Regions of benign hyperplasia are frequently observed. Conspicuous hyperplastic lymph follicles, which may be the result of subclinical inflammation, are frequently present. Their relation to the pathogenesis of the polyps may be of great importance.

7 Polyposis arising as a complication of chronic ulcerative colitis is characterized by widespread inflammation and destruction of the mucosa with inflammatory involvement

of the entire wall of the bowel. The polyps are composed of tufts of granulation tissue and of surviving remnants of mucosa in most of which benign regenerative hyperplasia is evident and in many of which true adenomatous and even carcinomatous proliferation ensues. Consequently, these polyps were classified as (1) pseudo adenomatous (2) adenomatous and (3) carcinomatous. The relative incidence of these types of polyposis associated with chronic ulcerative colitis and with multiple adenomatosis is. Of the multiple adenomatosis group, 100 per cent were adenomatous and of these 62.5 per cent were carcinomatous of the chronic ulcerative colitis group 56.2 per cent were pseudo adenomatous 21.9 were adenomatous and 21.9 per cent were carcinomatous.

8 The comparative study of polyposis complicating chronic ulcerative colitis in groups A and B revealed several significant facts. The relative incidence of polyps in group B was only 10 per cent as compared with an incidence of 13.8 per cent in group A. Inasmuch as it has been shown that the incidence increased with the severity of the disease this decreased incidence of polyps is more than likely attributable to improvements in the modern therapeutics of chronic ulcerative colitis. Improvement in roentgenological diagnosis was apparent in the fact that the polyps were demonstrated by roentgenological means in 33 per cent of the cases in the more recent group as compared to 10.6 per cent in the former. Surgical treatment was resorted to in 48.3 per cent of the earlier cases with an attendant mortality rate of 47 per cent whereas in the more recent group surgical procedures were used in only 13 per cent of the cases with a mortality rate of 66 per cent.

9 Polyps associated with chronic ulcerative colitis seem to be the result of widespread ulceration and destruction of the mucosa associated with remaining islets of inflammatory mucous membrane and followed by cicatricial distortion of the damaged lining of the bowel. The resulting polyps were predominantly pseudo adenomatous (56 per cent) although adenomatous changes were observed in 21.9 per cent. Carcinoma in these cases

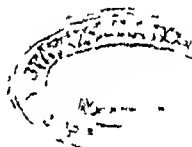
occurred with similar frequency (21.9 per cent).

10 It seems obvious therefore that from the standpoint of the probability of the development of carcinoma multiple adenomatosis is potentially a much more dangerous disease than polyposis associated with chronic ulcerative colitis.

REFERENCES

1. BARGEN J. A. Chronic ulcerative colitis associated with malignant disease. *Arch Surg* 1928 1, 561-576.
2. BARGEN J. A. and COMFORT M. W. The association of chronic ulcerative colitis and multiple polyp. *Ann Int Med* 1930 4 122-133.
3. BARRY J. C. M. and BARGEN J. A. The neoplastic factor in chronic ulcerative colitis. *New England J Med* 1934 210 602-606.
4. BLUE L. A. Polypoid disease of the colon. *J Indiana State M As* 1933 30 622-627.
5. CRIPPS W. H. Two cases of disseminated polyposis of the rectum. *Tr Path Soc Lond* 1882 33 163-168.
6. DALLS CUTHBERT. Sin le tumours of the large intestine and their relation to cancer. *Brit J Surg* 1926 13 720-733.
7. EDDYMAN J. F. and MORRIS J. H. Polyposis of the colon: a survey of the subject. *Surg Gynec & Obst* 1932 40 460-468.
8. FINEG JAMES. Neoplastic diseases. Ed 3. Philadelphia W. B. Saunders Co. 1928.
9. FANSLER W. A. The origin of polypi of the large bowel with special reference to adenoma. Preliminary report. *J Am M Ass* 1930 93 1960-1970.
10. FILLSEN JOSEPH. Intestinal polyposis: adenomatous colitis and polyposis is cystica intestinali. *Am J Digest Dis* 1936 3 589-593.
11. FEYRTAG FRIEDRICH. Zur Geschwulstlehre (nach Untersuchungen am menschlichen Darm). I. Polypen und Krebs. *Beitr z path Anat u z allg Path* 1931 86 663-660.
12. GENAHL I. I. and DIMITRUK J. D. Leber die Wirkung von Teer auf die Darmschleimhaut des Kaninchens. *Ztschr f Krebsforsch* 1895 27 352-358.
13. HEWITT J. H. and HOWARD W. T. Chronic ulcerative colitis with polyps: a consideration of the so-called colitis polyposa (Virchow). *Arch Int Med* 1915 15 714-723.
14. HOELZEL, FREDERICK and DA COSTA ESTHER. Experimental production of polyposis of the colon in rats. *Am J Digest Dis* 1933 4 23-26.
15. HORGAN EDMUND. Colectomy for chronic ulcerative colitis and polyps. Report of a case. *Med Ann District of Columbia* 1932 1 292-294.
16. HILLISIER H. F. Multiple polyposis is of the colon. *Surg Gynec & Obst* 1928 4 346-356.
17. HURST A. F. Ulcerative colitis. *Guy s Ho p Rep* 1935 85 347-355.
18. KENNEDY R. L. J. and WEBER H. M. Polyposis of the colon in children. *Am J Dis. Child* 1931 42 69-6.
19. LEBERT. Quoted by Hewitt, J. H. and Howard W. T.
20. LOCKHART MUMFERY J. P. The causation and treatment of multiple adenomatosis of the colon. *Ann Surg* 1934 99 1-8-14.

- 21 LOCKHART MUMMERY J P and DUKES CUTHBERT
The precancerous changes in the rectum and colon
Surg, Gynec & Obst 1928, 46 591-596
- 22 McKENNEY, D C Multiple polyposis of colon fa-
milial factor and malignant tendency J Am M
Ass, 1936 107 1871-1876
- 23 MAYO, C W and WAKEFIELD E G Disseminated
polyposis of the colon a new surgical treatment in
selected cases J Am M Ass 1936, 107 342-347
- 24 MENZEL Quoted by Hewitt J H, and Howard
W T
- 25 RANKIN F W Total colectomy, its indication and
technic Tr Am Surg Ass 1931 40 263-283
- 26 RIBBERT Quoted by Feyrter Friedrich
- 27 ROKITANSKY CARL Quoted by Woodward J J
- 28 SAINT J H Polypi of the intestine Brit J Surg
1927 15 99-119
- 29 SCHMIEDEN V and WESTHUES H Zur Klinik und
Pathologie der Dickdarmpolyphen und deren klini-
schen und pathologisch anatomischen Beziehungen
zum Dickdarmkarzinom Deutsche Ztschr f Chir,
1927, 202 1-124
- 30 SOPER H W Polyposis of the colon Am J M Sc,
1916 151 405-409
- 31 SUSMAN, WILLIAM Polypi coli J Path & Bacteriol,
1932 35 29-33
- 32 VERSE Quoted by Ewing James
- 33 VIRCHOW R Quoted by Wesson, H R, and Bargaen,
J A
- 34 WAGNER JOHANN Quoted by Woodward J J
- 35 WESSON H R and BARGEN J A Classification of
polyps of the large intestine Proc Staff Meet
Mayo Clinic, 1934 9 789-794
- 36 WHEELER W I DE C Multiple polypi of the colon
Brit J Surg 1926 14 58-66
- 37 WOODWARD, J J Pseudo polypi of the colon an
anomalous result of follicular ulceration Am J
M Sc 1881 81 142-155



TETANUS AT THE JOHN SEALY HOSPITAL

Observations upon the Distribution of Tetanus throughout the United States

R M MOORE M.D., F.A.C.S. and A O SINGLETON M.D. F.A.C.S.
Galveston Texas

DURING the period 1903 to 1938 there have been 102 cases of tetanus treated on the surgical service of the John Sealy Hospital Galveston and locally it has become a belief that tetanus is peculiarly common in this vicinity. Recently while reviewing these cases we have taken occasion to inquire into the distribution of tetanus throughout the United States. The annual mortality statistics report of the Bureau of Census enumerates the deaths from tetanus in each state of the registration area but supplies the death rate per 100 000 population only for the area as a whole. Using the enumeration of deaths and the Bureau's annual estimation of populations we have computed the death rate from tetanus per million population for each state and for each year of the period 1923 to 1935. Certain of the data thus obtained are sufficiently informative to merit presentation at this time in conjunction with a report of the experience with tetanus at the John Sealy Hospital.

GEOGRAPHIC DISTRIBUTION OF TETANUS

Gessner (1918) Graffiagnino and Davidson (1924) Graves (1930) and Boyce and McFetridge (1935) have reported 998 cases of tetanus treated at the New Orleans Charity Hospital during the period 1906 to 1934 whereas 90 patients were treated in the John Sealy Hospital during these years. Thus Charity Hospital encountered 11 times as many cases during a period in which the population of New Orleans averaged 8.6 times that of Galveston. Apparently tetanus is equally as common in New Orleans. There is no doubt but that the disease is more prevalent both in Galveston and in New Orleans than in the

cities of the North. In 1937 Huntington, Thompson and Gordon were able to collect only 642 cases from the records of 18 hospitals situated in the northeastern quarter of the United States. These hospitals totalled about 10 000 beds and a number of the cases occurred prior to 1903. In comparison the Charity Hospital and the John Sealy Hospital having a combined capacity of less than 2,000 beds have treated over 1,100 patients with tetanus since 1903. It is obvious that tetanus occurs more commonly in the Gulf Coast region than in the northeastern section of the country.

To obtain a more satisfactory estimate of the geographic distribution of the disease we have constructed the map shown in Figure 1 from data compiled from the *Mortality Statistics of the Bureau of Census*. The years 1933, 1934 and 1935 were chosen because the reports for these years are the only ones available which include Texas, this state not having joined the registration area until 1933. The map shows that deaths from tetanus are much more common in the southern states and particularly in those states bordering upon the Gulf.

A study of the literature reveals that for tetanus the mortality rate in treated patients has been fairly uniform throughout the country. Therefore in the absence of dependable figures bearing directly upon the incidence of tetanus we feel justified in assuming that the data upon deaths from the disease presented in Figure 1 can be considered a fair index of the geographic incidence of tetanus.¹

Factors explaining the geographic distribution. A high incidence of tetanus has ordinarily been considered an accompaniment

¹ From the Department of Surgery, University of Texas School of Medicine.

¹As will be shown later the number of deaths is not necessarily a good index of the incidence of tetanus in states having a large negro population.

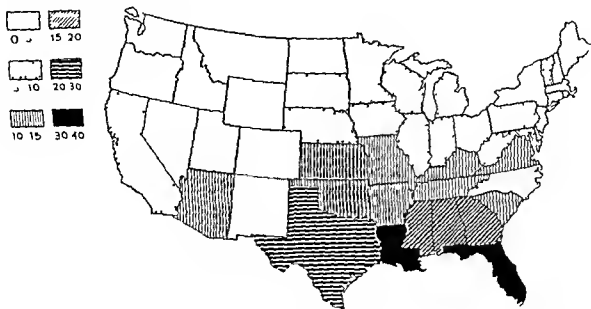


Fig. 1. Average annual deaths from tetanus per million population based upon the years 1933, 1934 and 1935 and the official 1930 populations

of intensive cultivation and fertilization of the soil. However, it is impossible to account for the findings shown in Figure 1 solely by soil culture. The relatively low incidence in the midwestern farming states and in the old cultivated states of the northeast defies explanation on this basis. Other factors must be considered: (1) The influence of climate upon the growth of tetanus bacilli in the soil, (2) a difference in the susceptibility of the population, particularly with reference to the large negro population in the states bordering upon the Gulf, (3) the outdoor life throughout the year in the most southern regions together with the custom that many people have of going without shoes, and (4) ineffective treatment of wounds and failure to use antitoxin in prophylaxis in the areas where tetanus is prevalent.

Although the high incidence of tetanus in the Gulf States may depend in part upon the character of the soil, climatic factors must be important. High mean annual temperature, absence of winter freezing, copious rainfall, and great humidity possibly combine to favor the growth of the bacillus in the soil. If the great prevalence in the Gulf Coast region is conditioned by this subtropical, maritime climate there should be a sharp contrast between the incidence in the coastal plains of Texas and that in the higher, drier portions

of the state. The State Department of Health has been unable to furnish data for us to make this comparison, but through city health officers we have obtained information which permits a comparison of 5 cities of the state over an 11 year period. During the years 1927 to 1937 the average annual deaths from tetanus expressed as deaths per million population were as follows: Galveston, 32, Houston, 22, Fort Worth, 21, El Paso, 15, and San Antonio, 41.

The low rate in El Paso is in line with its warm but dry climate. The city, which lies at an elevation of nearly 4,000 feet, has an annual rainfall of only 9 inches. Furthermore, the city is not an agricultural center. On the other hand the high rate in San Antonio is somewhat perplexing. Although this city is warm it has a much drier climate than either Galveston or Houston, a fact demonstrating that the distribution of tetanus in Texas cannot be entirely a function of the rainfall. San Antonio, however, does lie in a farming region and the population includes a considerable proportion of Mexicans of the laboring class who are notorious for their unhygienic mode of life and reluctance to seek medical care.

For those states having a large negro population the Bureau of Census in its Mortality Statistics separates the negro and white populations. Consequently it has been possible to



Figs 2 and 3 Comparison of tetanus death rates for white and negro populations based upon the years 1933, 1934 and 1935 and the official 1930 populations. Figure 2 shows the average annual deaths from tetanus among



the white population of 14 southern states. Figure 3 shows the average annual deaths from tetanus among the negro population of 14 southern states. The death rate is higher for negroes except in Oklahoma.

prepare Figure 2 mapping the deaths from tetanus in the south on the basis of white population alone. Comparing the shading in this map with that in Figure 1 it is apparent that the death rate from tetanus in whites has not been particularly high except in the states of Florida, Louisiana and Texas. In these 3 states the rate has exceeded that elsewhere in the country again suggesting a climatic factor.

Figure 3 shows the death rates from tetanus among the negro population in the south. In every state but Oklahoma the rate has been higher for negroes than for whites and in many states the difference is startling. In the absence of adequate data bearing directly upon the morbidity it is impossible to state whether the high death rate among negroes is due to a greater incidence of the disease or to a higher mortality. It would seem safe to presume that both factors play a part. The great majority of negroes in the South are engaged in manual pursuits. Soil contamination of wounds must be a common occurrence particularly in view of the practice of going barefooted. Inadequate care of wounds and failure to use anti-toxin in prophylaxis would result in a high incidence of tetanus. Once the disease is contracted, delay or failure in receiving medical attention would lead to a high mortality.

The view that the high death rate in negroes is due to such factors rather than to a racial susceptibility is strengthened by the experience in Galveston where the John Sealy Hospital has offered the colored population free and adequate treatment of wounds. During the past 15 years exactly one third of tetanus deaths in Galveston have been in negroes

whereas the negroes have constituted one fourth of the population (23.2 per cent in 1929). This slight disparity might reasonably be explained on an occupational basis. At the John Sealy Hospital over a 15 year period negroes constituted 32 per cent of admissions and 33 per cent of tetanus cases. In our series of 102 cases of tetanus the mortality among negro patients was 44.1 per cent as compared to 52.9 per cent among white patients. These figures argue against any significant racial susceptibility to tetanus. Consequently it is our belief that the death rate from tetanus in the South is higher among negroes because the negroes are engaged in manual pursuits in much greater proportion and they are under social and economic conditions which deny them effective prophylaxis as well as adequate treatment for the disease.

The trend in the death rate from tetanus. For the Registration Area as a whole there were 17 tetanus deaths per million population in 1923. This figure had decreased to 8 deaths per million by 1935. In 1923 among infectious and parasitic diseases tetanus ranked thirteenth in importance as a cause of death. In 1935 it was still thirteenth. Thus progress in prevention of fatal tetanus has kept pace with that in prevention of other infectious disease. Throughout this period there was a decrease in the tetanus death rate in every state but Idaho where a very low rate remained practically unchanged.

Figure 4 illustrates the trend in the death rate from tetanus for the negro population. The heavy line indicates the death rate for the entire population of the United States

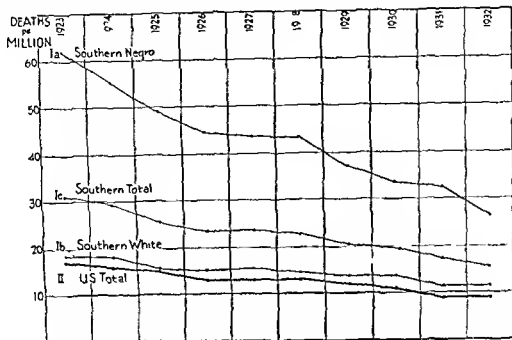


Fig. 4. Trend in death rate from tetanus for the 10 year period 1923 to 1932 Ia southern negro Ib southern white Ic southern total, II entire U S Registration Area

registration area for the years 1923 to 1932. Comparable curves are shown for the negro, white, and total populations of the 9 southern states which were in the area throughout this period¹. It is seen that there was a relatively greater decrease in tetanus deaths among the southern negroes than among the southern whites or among the entire population of all the registered states. This very favorable trend affecting the source of the highest mortality is further emphasized when one compares the death rate curve for the registration area as a whole with curves for the 3 states showing the highest rates in Figures 2 and 3. Thus, while the tetanus death rate for the entire area decreased from 17 per million in 1923 to 8 per million in 1935, the rate for Florida decreased from 64 to 32 and that for Louisiana dropped from 94 to 27.5. Unofficial figures indicate a similar decrease in Texas. Again it is seen that the greatest improvement has occurred in the areas where it was most needed. Nevertheless, it is in these regions that tetanus is still most prevalent.

TETANUS AT THE JOHN SEALY HOSPITAL

1 Incidence In our judgment the high incidence of tetanus in Galveston has de-

pended upon a soil rich in tetanus bacilli. The city was built upon a sand bar in the Gulf of Mexico and intensive fertilization has been practiced throughout the 100 years of its existence. Furthermore, the climate is warm and very moist. Outdoor sports are popular throughout the year. We believe that other causes of a high incidence of tetanus are not important locally. The disease is feared and physicians treat wounds radically and give antitoxin routinely. In the presence of an effective free clinic a large negro population has not materially increased the tetanus rate. Although many children go barefooted, wounds about the foot have accounted for less than one third of our cases and for only 15 of 41 patients under 14 years of age. In view of these considerations it would seem that the prevalence of tetanus is largely a reflection of the climate and of the soil.

Incidence in relation to race, sex, and age Whereas negro patients comprised 32 per cent of the John Sealy Hospital admissions (1920 to 1935), they constituted 33 per cent of the 102 cases of tetanus treated. Although the local population is only 25 per cent negro, this disparity might be predicted upon an occupational basis alone. Thirty-six and two-tenths per cent of the 102 cases of tetanus were female patients. Charity Hospital re-

¹Florida Kentucky Louisiana Maryland Mississippi North Carolina South Carolina Tennessee and Virginia

TABLE I—INCIDENCE OF TETANUS AT THE JOHN SEELY HOSPITAL

Classification	Case number	Mortality per cent
Entire series	102	50.0
Race		
White	65	52.0
Negro	37	44.1
Sex		
Male	63	52.4
Female	39	46.2
Age in years		
1-10	30	46.6
10-20	15	46.6
20-30	19	42.1
30-40	14	57.1
40-50	12	66.6
50-60	5	20.0
60-70	2	50.0
70-80	1	100.0
Site of wound		
Lower extremity	40	37.5
Upper extremity	24	62.5
Head and neck	3	66.6
Internal (criminal abortion operation)	20	55.0
Type of wound		
Puncture wound	31	35.5
Blank pistol wound	4	75.0
Other accidental wound	20	50.0
Smallpox vaccination	10	100.0
Hypodermic wound in drug addict	4	75.0
Chronic leg ulcer	3	0.0
Criminal abortion	17	52.9
Surgical operation	3	66.6

ported that 37.3 per cent of their tetanus patients were female (3). When the cases arising from criminal abortion, vaccination, surgical operation, etc., are excluded, one finds that only 19.6 per cent of the cases arising from accidental wounds were female patients. Presumably this figure signifies the low proportion of traumatic wounds occurring in female subjects. In 98 of the 102 cases the age was recorded. The distribution in relation to decades is shown in Table I. The great incidence during the first decade of life and the low incidence in persons past 50 years is attributed chiefly to differences in habit and in activity, although a difference in susceptibility also may exist. Of the 30 cases in persons less than 10 years of age 10 were due to puncture wounds of the foot and 5 to smallpox vaccination wounds.

Incidence in relation to site and type of wound. Table I shows the portal of entry of the tetanus bacillus in 92 cases. In the other 10 cases the wound was unknown. Although a puncture wound was the commonest cause

in 15 instances the disease arose from a laceration. The 10 cases resulting from infected vaccination wounds were scattered throughout the years 1914 to 1933 of the cases occurring in 1925. The cases which arose from surgical operations followed the removal of a gangrenous appendix in 2 instances and an accidental tear of the ileum repaired at operation in the other instance.

Incidence in relation to the prophylactic use of tetanus antitoxin. Although there is no doubt that the prophylactic use of tetanus antitoxin has done much to decrease the incidence of tetanus, it is generally known that the disease can occur in patients who have been administered the serum for prophylaxis. The Charity Hospital reported 13 such cases with 9 fatalities (3). We know of 2 such cases in our series. In 1936 a child developed fatal tetanus 4 days after receiving 3,000 units of antitoxin. In 1937 an adult diabetic developed tetanus 17 days after suffering a compound dislocation of a toe resulting in gangrene of the foot but only 3 days after receiving 3,000 units of antitoxin. She recovered after amputation of the leg.

It is generally stated that antitoxin remains in the blood stream for less than 10 days and for this reason the United States Army requires that a second dose be administered after 1 week. In view of the impression that in rare cases the antitoxin does not prevent the disease it at least delays it, it is important to note that both of the cases cited developed within the first week after serum prophylaxis.

Mortality. One hundred and two patients with tetanus were treated at the John Seely Hospital during the period 1903 to 1938. A few cases so mild as to be doubtful, have not been included in the series and several cases of babies with tetanus neonatorum treated on the gynecological service have been omitted. Otherwise the study includes all tetanus diagnosed during this period. Since the value of tetanus antitoxin was demonstrated by von Behring in 1890, the serum coming into general use a few years later, this entire series falls within the antitoxin era, every case receiving at least a small amount of antitoxin.

The mortality for the entire series of 102 cases was exactly 50 per cent. In Table II

MOORE, SINGLETON TETANUS AT THE JOHN SEALY HOSPITAL

this mortality is compared with that reported by certain other hospitals for approximately the same period of years. The table shows that the local mortality was lower, and, from a statistical standpoint, significantly lower. In view of our limited number of cases, however, it is possible that the difference is only apparent. The decrease in mortality during recent years is discussed elsewhere.

Mortality in relation to race, sex and age. In this hospital a slightly higher mortality was observed in white patients than in negroes but the difference is not sufficient to be significant (Table II). Boyce and McPetridge in 1935 reported that in New Orleans the mortality was greater among the blacks. This they blame upon a tendency of the southern negro to delay medical consultation. It is true that in the Galveston series there has been some indication of such a delay, only 39 per cent of the negro patients having entered the hospital during the first 2 days of the disease as compared with 60 per cent of the whites. In spite of this delay a lower mortality was observed in the negroes which is surprising. Evidence will be presented, however, to indicate that most cases of tetanus which delay medical consultation unduly are mild cases of the disease.

As shown in Table II there was no significant difference between the mortality in male and that in female patients. With respect to the influence of age our series does not permit an accurate appraisal, the number of cases in the upper age brackets being too small (Table I). By dividing the patients into 2 age groups (Table II), a somewhat higher rate was suggested for patients over 40.

Mortality in relation to incubation period. It has been a rather general belief that the cases of tetanus developing after a short incubation period are apt to be more serious. However, from experience at the Charity Hospital, Boyce and McPetridge (1935) state that "the relationship between incubation period and mortality rate is a tendency rather than a fact." Huntington, Thompson, and Gordon (1937) conclude that a rapid progression of symptoms after the onset is a more reliable index of grave prognosis than is a short incubation period. Observations in our

TABLE II—STATISTICAL STUDY OF TETANUS TREATED AT THE JOHN SEALY HOSPITAL

Classification	Cases number	Mortality per cent	Difference in mortality per cent	Chi square	Approximate probability per cent
Race					
White	68	52.9			
Negro	34	44.1	8.9	0.71	40
Sex					
Male	63	52.4			
Female	39	46.2	6.2	0.37	55
Age in years					
Under 40	78	47.4			
Over 40	0	55.0	7.6	0.36	55
Site of wound					
Lower extremity	40	32.5			
Upper extremity	24	62.5	30.0	5.49	2
Incubation period					
5 days or less	12	25.0			
More than 5 days	38	50.0	25.0	2.50	11
10 days or less	45	44.4			
More than 10 days	25	48.0	3.6	0.08	78
Day of disease admitted					
Third day or before	61	57.3			
After third day	23	21.7	35.6	8.50	0.3
Trend in mortality					
First 75 cases	75	59.7			
Last 27 cases	27	25.9	3.8	8.51	0.3

There were 102 cases at the John Sealy Hospital and the mortality was 50 per cent. There were 163 cases from other selected hospitals. This figure has been compiled from the 4 reports upon tetanus at the Charity Hospital, New Orleans, and from Huntington, Thompson and Gordon's collection of cases from 18 hospitals in the northeastern quarter of the United States. Mortality in this group was 62.7 per cent difference in mortality, 12.7 per cent; chi square 6.54; approximate probability 1 per cent.

The figure given represents the approximate probability that the difference observed in the mortality is due merely to chance. Ordinarily values below 5 per cent are suggestive of significance whereas 1 per cent is considered strongly indicative of significance.

series tend to corroborate this opinion. As shown in Table II a higher mortality rate was observed in the cases in which the incubation period was longer. Although the difference observed was not sufficient to warrant the conclusion that a short period is favorable, it does suffice to indicate that in any given case an accurate prognosis cannot be based upon the length of the incubation period. Furthermore, it is well to stress that in many cases the incubation period which one can calculate is only an apparent incubation period and is not necessarily the true one.

Mortality in relation to duration of symptoms prior to hospital admission. As shown in Table II it was possible to calculate the day of the disease upon which the patient sought hospitalization in 84 of the 102 cases. The mortality was so much greater among those

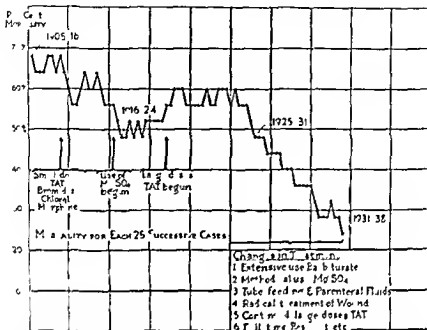


Fig. 5 Correlation of mortality in tetanus with treatment phase upon 102 cases treated at the John Sealy Hospital. The 78 points on the curve represent the percentage mortality in each series of 25 successive cases beginning with Cases 1 to 25 at the left followed by Cases 2 to 26, 3 to 27, etc. to end with Cases 78 to 102 at extreme right.

entering during the first 3 days of the disease that its significance cannot be questioned. This finding confirms the opinion of Huntington Thompson and Gordon (1937) that a rapid progression of symptoms is a bad omen in tetanus and that patients whose symptoms compel them to seek hospitalization within 24 hours of the onset of the disease are patients with severe tetanus. The experience in Galveston has led us to conclude that tetanus which becomes marked within 48 hours of the first prodromal symptom is very serious. Furthermore we believe that in any case of tetanus a forecast should be withheld until the response to 24 hours of hospital treatment has been determined.

Mortality in relation to treatment. In studying our series of 102 cases of tetanus it immediately became apparent that during recent years the mortality has been lower. A very significant difference between the rate for the first three quarters of the series and that for the last one quarter is shown in Table II. We have no reason to believe that the lowered mortality indicates a milder form

of the disease. Many of the recent cases have been severe but a number which seemed hopeless have been recovered. For this reason the records have been studied carefully in an attempt to correlate the lowering of mortality rate with changes in the treatment.

To picture the trend in the mortality in tetanus in this hospital since 1905, we have numbered the 102 cases in order of hospitalization and have determined the percentage mortality for each of the possible 78 series of 25 successive cases. These mortality figures are plotted to form a horizontal curve in Figure 5, beginning with Cases 1 to 25 at the first point on the left, followed by Cases 2 to 26 and so on to terminate with Cases 78 to 102 at the extreme right. It is evident that since 1925 there has been a continuous and progressive lowering of the mortality rate below any previous figure until for the last 25 cases there have been only 6 deaths as compared to 19 recoveries, a mortality of 24 per cent. It is our belief that this result must be attributed to improvements in therapy. A chronological survey will show this.

Prior to 1920 no patient received in treatment as much as 50,000 units of antitoxin. For sedation one depended entirely upon chloral hydrate and bromides with occasional hypodermics of morphine. The causative wound was sometimes excised and in other instances was simply cauterized with phenol. During this period the mortality rate was high. In 1916, following the work of Meltzer, the hypodermic use of 25 per cent magnesium sulphate was introduced in the hope that it would aid in relieving spasm. For a number of years, however, it was given in a hit or miss fashion so that the drug did not receive a fair trial. In 1920 the dosage of antitoxin was greatly increased and since that time the total amount administered to patients recovering from the disease has averaged 140,000 units. Nevertheless, in spite of this change, the mortality rate remained high until 1926.

In contrasting the treatment during the past 10 or 12 years some points require mention.

1 Barbiturates, particularly luminal, sodium luminal, and sodium amytal, have served as the chief sedatives. Chloral hydrate is still used in some cases. Our experience with avertin is too slight to warrant an opinion.¹

2 Magnesium sulphate in 25 per cent solution has been given intramuscularly or subcutaneously in 2 to 6 cubic centimeter doses and repeated each 4 hours as long as it has seemed needed. We believe that in many cases this methodical use of the drug has been a valuable adjunct in relaxing spasm.

The use of barbiturates and of magnesium sulphate, both in huge doses, is founded upon the belief that the patient with tetanus is benefited if muscular rigidity is relieved. In most instances this combination of drugs has produced muscular relaxation and has also prevented clonic disturbances. In view of the work of Abel, Hampil and Jonas in 1935 and that of Firor and Lamont in 1938, suggesting that the rigidity of tetanus is a result of the action of the toxin upon voluntary muscle whereas the clonic spasms arise as a central nervous effect, it is of interest to recall that although the action of barbiturates is largely upon the central nervous system magnesium

sulphate has been shown to depress irritability in living cells of all types (10).

3 A great deal of effort has been directed toward maintaining the patient's caloric and fluid requirements. In severe cases this has meant high caloric feedings through a retained nasal catheter in conjunction with saline hypodermoclysis twice daily.

4 Whenever possible the external causative wound has been subjected to radical debridement immediately upon admission. Whether such wound excision influences the course of tetanus once the disease has developed is open to question. To us it has seemed rational to remove the necrotic tissue and to establish aerobic conditions.

5 The use of large doses of tetanus antitoxin has been continued. We feel that the patient with tetanus needs every possible chance if he is to recover and we have been unwilling to dispense with antitoxin although many are questioning its therapeutic value.

6 The period under consideration has marked the addition to the surgical staff of full-time men including resident and assistant resident. The constant presence of highly trained men has meant that the patient can be watched very closely. We recall instances in which such men have spent hours at the bed of a patient and have literally refused to give up the fight.

A recent case may be cited as an example of heroic use of drugs and constant attention of the house staff.

A white male, aged 25, entered with severe tetanus on the second day of the disease and after an incubation period of 5 days. First, the puncture wound of the foot was treated radically. During the active stage of the disease tube feeding was maintained while saline and 5 per cent glucose was administered by hypodermoclysis. The patient received 78 grains of sodium luminal during the first 3 days and 800 grains of chloral hydrate thereafter. In addition he was given 1,693 cubic centimeters of 25 per cent magnesium sulphate by 4 cubic centimeter hypodermic injections and numerous doses of sodium amytal and morphine sulphate. A total of 315,000 units of tetanus antitoxin was administered. Until relaxation was secured frequent convulsions required etherization. For some days his condition appeared hopeless but the house staff were untiring in their efforts and the patient survived. It is our experience that such patients usually die when the care is relegated to the nurses and directed by standing orders.

¹We have had no experience with the intravenous phenol treatment used so successfully by Beall (1924) or with the atropine antitoxin and atropin antitoxin methods cited by Dejou (1933).

SUMMARY

In the absence of data bearing directly upon the incidence of tetanus the data upon deaths from tetanus supplied by the *Mortality Statistics of the Bureau of Census* can be used as an index to the geographic distribution of the disease. Although the tetanus death rate for the United States has been reduced by one half during the last 15 years, the disease still causes over 1,000 deaths annually. Maps are presented (Figs. 1, 2 and 3) which illustrate that tetanus deaths are relatively much more common in the southern states where an excessively high mortality occurs in the negro population. From local experience in Galveston it is concluded that this high death rate from tetanus among southern negroes results from social economic and occupational influences rather than from any racial susceptibility. A promising trend is seen in that recent years have witnessed a decrease in the tetanus death rate for southern negroes which is even greater than the decrease for southern whites or for the entire population of the Registration Area (Fig. 4).

The death rate from tetanus for the southern white population is excessive only in those states having long coastal borders on the Gulf of Mexico namely in Florida, Louisiana and Texas. In regard to these states the possible effect of their moist subtropical climate is discussed. As regards Galveston where an effective free clinic has resulted in rates approximately equal for blacks and whites it is felt that the high incidence has been primarily a reflection of the effects of long continued fertilization and a warm moist climate in favoring the growth of tetanus bacilli in the soil.

During the period 1903 to 1938 the incidence of tetanus at the John Sealy Hospital was 0.83 case for each 1,000 hospital admissions. One hundred and two cases are listed according to race, sex, age and cause in Table I. As shown in Table II the mortality was higher in cases arising from wounds of the upper extremity. There was no evidence that a short incubation

period was of grave prognosis on the contrary the mortality was actually greater in cases in which the incubation period exceeded 5 days. It was found however that the mortality was significantly higher among those patients whose symptoms compelled them to seek hospitalization during the first 3 days of the disease than among those entering later in their illness. Apparently a rapid progression of symptoms is the bad omen in tetanus.

The mortality rate for the entire John Sealy Hospital series was exactly 50 per cent. This figure is significantly lower than that found in other reports (Table II). Furthermore a decrease in mortality to 24 per cent for the last 25 cases (6 deaths and 19 recoveries) is shown in Figure 5. An attempt to correlate this lowering of mortality with changes in treatment has been made. It is concluded that in the past the mortality rate in tetanus often has been excessive and that a great lowering of mortality can be brought about through the energetic application of simple therapeutic measures available in any general hospital.

BIBLIOGRAPHY

1. ADEL, J. J. HAMIL, B. and JONES, A. F. Researches on tetanus III. Bull. Johns Hopkins Hosp. 1935, 56, 317.
2. BFALL, K. H. Texas State J. M. 1924, 20, 54.
3. BOYCE, F. F. and McFETRIDGE, E. M. An analysis of 185 cases of tetanus from the New Orleans Charity Hospital. New Orleans M. & S. J. 1935, 87, 825.
4. DEJOC, L. Considerations sur le tétanos tropical. Rev. de chir. 1938, 57, 582.
5. FIBOR, W. M. and LAUNOY, A. The apparent alteration of tetanus antitoxin within the spinal cord of dogs. Ann. Surg. 1938, 109, 941.
6. GESSNER, H. B. Therapeutics of tetanus. J. Am. M. Ass. 1918, 71, 867.
7. GRAFFAGNINO, P. and DAVIDSON, J. M. Tetanus. New Orleans M. & S. J. 1924, 76, 311.
8. GRAVES, A. M. Tetanus in New Orleans: analysis of 913 cases. Ann. Surg. 1930, 92, 1075.
9. HUNTINGTON, R. W. JR. THOMPSON, W. R. and GORDON, H. H. The treatment of tetanus with antitoxin. Ann. Surg. 1931, 105, 93.
10. LILLIE, R. S. Protoplasmic Action and Nervous Action. Chicago: University of Chicago Press, 1923.
11. MELTZER, S. J. and ALER, J. The narcotizing effect of magnesium salts upon nerve fibers. Am. J. Physiol. 1906, 16, 231.
12. Mortality Statistics. U. S. Dept. of Commerce Bureau of the Census. Washington. U. S. Govt. Printing Office 1923-1935 incl.

RESULTS OF ATTEMPTED INDUCTION OF LABOR WITH ESTRIN

SAMUEL RUBIN, M.D., F.A.C.S. and RICHARD WELLMAN, B.A., M.D.,
Brooklyn, New York

THE cause of the onset of labor has been postulated by many investigators. However, in recent years, with a clearer understanding of the hormone blood levels, both in the pregnant and non pregnant state, the role of sex hormones has become significant. Since pregnancy is a physiological state bordering on the pathological, in which the hormone balance is necessarily a delicate one, any imbalance might result in a disturbance in the organ which contains the gestation. With experimental knowledge of this fact a few investigators have attempted to empty the uterus, both early as well as late in pregnancy. Animal experimentation has naturally been more widespread than human. Based on the complicating reports in the literature relative to the effectiveness of estrin in terminating pregnancy, we have undertaken this study.

A sufficient amount of experimental work has been carried out by various observers to substantiate the fact that uterine motility and contractility can be initiated and maintained by estrin. Whether or not these contractions are induced by the direct action of estrin or indirectly by sensitizing the uterus to the action of pituitrin is a debatable point. More credence was given to the latter view at the time Bourne and Burn (3) showed that when a uterus of a guinea pig was isolated and first treated with estrin, its contractions following addition of pituitrin were twice as great as without previous treatment with estrin. Subsequently (4) these investigators withdrew this opinion. It is known (18), however, that pregnant rats, rabbits, and cats with the pars posterior and pars intermedia of the hypophysis removed, experience labor in the normal manner. In addition, Reynolds and Eror (19) have demonstrated that estrin exerts its effect

upon the rhythmic motility and uterine activity in the completely hypophysectomized rabbit in the same low dosage as in the intact animal.

It has been shown that rhythmic uterine contractions can be induced by estrin in certain animals during pregnancy, so that the products of conception may be expelled. This has been demonstrated by several investigators. Parkes and Bellerby (15) found that they could produce abortion in mice by the injection of estrin early in pregnancy. However, as pregnancy advanced, the dosage of estrin necessary to terminate the pregnancy increased. Kelly produced abortion in the guinea pig by estrin at varying stages of pregnancy. In the unanesthetized rabbit Reynolds and Eror (20) found that the uterus is refractory to the motility inducing action of theelin until the twenty sixth day of pregnancy, but on the twenty seventh day the injection of theelin leads to abortion and death. D'Amour and Gustavson claim to have terminated pregnancy in the rat by estrin administration and other successful interruptions have been reported in mice by Aschheim and Zondek, Fraenkel and Fels, and in rats by M. Smith.

It has been shown that the estrin level in the human rises in the latter part of pregnancy, which suggests its possible utilization in association with the onset of labor at term. The increase in the concentration of this hormone toward the end of pregnancy has been demonstrated independently by different observers. Thus Smith and Smith (24) have shown during normal pregnancy an increase of estrin from the fourth month on, with a rapid rise during the last trimester. Runge, Hartman, and Sievers have also found a sharp increase in estrin production and excretion in the few weeks preceding parturition. An ab

normal rise of blood and urine levels of estrin for some time preceding spontaneous abortion in the human has been reported by Jeffcoate, Cohen, Marrian, and Watson have shown an increased urinary output of estrin just before labor. In addition, Zondek demonstrated a rise in estrin production during gestation which is at its highest level at the time of parturition. Knaus also states that the production of estrous hormone increases as pregnancy advances while the anterior pituitary hormone production decreases. Accompanying this, there is a gradual degeneration of the corpus luteum with an increased susceptibility of the highly contractile uterine musculature to the action of posterior pituitary secretion. Collectively, these reports point toward the probable significance of the rôle of estrin in the onset of labor.

One may question the importance of increased estrin levels inasmuch as Møller, Christensen, and Pedersen Bjergaard believe that there is no difference between estrin production during childbearing in women who have normal labors and in women who have primary inertia uteri. In addition, Bourne and Bell (2) failed to induce uterine contractions in the human by massive doses of estrin. They feel that estrin probably has no effect on the initiation or course of labor and found no discernible difference in the estrin content of the urine in normal and delayed labor.

Correlation of these findings to the onset of labor in the human has been attempted by clinicians in an effort to induce labor by the administration of estrin. Thus Voron, Brochier, and Contamin successfully induced labor in prolonged pregnancy by the combined use of folliculin and posterior pituitary substance. Of course, one cannot accept this as estrin induced labor because of the supplementary use of posterior pituitary substance. Gonnet, Bansillon, and Bueber successfully induced labor by means of estrogenic substance in addition to purging quinine, and pituitary extract. One hesitates to accept this as an example of the successful induction of labor by estrogenic substance inasmuch as the latter three agents might in themselves be successful in inducing labor. Witherspoon believes that the ascendancy of follicular hor-

mone over the luteinizing hormone to be the cause of labor, attempted unsuccessfully to induce labor in 8 humans. Dodds and Robertson, in attempting to procure premature labor in 3 cases using some 300 units of estrin, were successful in only one but feel their results were inconclusive.

Perhaps one of the most definite clinical reports was the one by Robinson, Datnow, and Jeffcoate. They tried the effect of theelin in inducing abortion, premature labor, missed abortion, and in uterine inertia. Their attempts at inducing abortion were unsuccessful in 12 cases although hemorrhage and uterine contractions were produced in 3. In 10 attempts to induce premature labor, quinine and pituitrin were used in addition to estrin and labor resulted 5 times. The labors were noticeably shorter which the authors attribute to the previously injected hormone. Success was obtained in 10 of 12 cases of missed abortion. In 7 of these 10, nothing but estrin was used. In the remainder quinine and pituitrin were used in addition. They thought that estrin was of value in overcoming uterine inertia. The basis for the usage of estrin to terminate missed abortion was probably the report by Spielman, Goldberger, and Frank showing an absence of demonstrable blood estrin in such cases.

Savage, Wylie, and Douglass studied the effect of estrin administration to toxemic patients during pregnancy. They felt that in 4 cases the hormone possibly might have had some part in the induction of labor. They also believed that the short average duration of labor in the 9 patients treated with theelin might possibly have been the result of the theelin therapy. Reynolds (19, 20) is of the opinion that the increasing disproportion of the growth rates between the fetus and uterus toward the end of pregnancy is due largely if not entirely to the influence of estrin. This in addition to the motility stimulating action of estrin upon the myometrium, he feels, may be responsible for the onset of labor.

The accumulated data presented do not support the fact that estrin solely is responsible for the onset of labor since additional factors were present which are equally significant. Nevertheless the rôle of estrin has been

shown to be an important one, necessary in the onset of labor. Our attempts have been directed toward inducing labor in the human, near, at, or beyond, term by the administration of estrin without the aid of supplementary procedures or substances.

ANALYSIS OF PRESENT STUDIES

Estrin¹ was administered to 36 patients near, at, or beyond, term in an attempt to induce labor. Of these, there were 27 multipara and 9 primipara. Only those cases were chosen for this series in which there was no question of delivery by other than the vaginal route. The injections were given intramuscularly in the gluteal region and the total dosage per patient ranged from 10,000 to 350,000 international units. The number of injections to each patient varied from 1 to 6. Twenty-four patients received 1 injection, 9 patients received 2 injections, and 1 each received 3, 4, and 6 injections, respectively. When more than 1 injection was employed, the interval between injections was usually 24 hours. However, in 2 cases, the interval was 1 week, and in 1 case, the interval was 14 days.

The period of gestation ranged from 38 to 45 weeks. In 3 cases it was under 40 weeks, and in the 33 remaining cases 40 weeks or over. In 8 cases in which patients apparently responded following the estrin administration, the period of gestation was 41 weeks in 5 and the 3 remaining were of 42, 44, and 45 weeks, respectively.

The membranes were intact in all 8 cases which apparently responded. This would rule out the possibility of at least one adjuvant contributing factor to the onset of labor.

We have been guided in the determination of whether estrin played a role in inducing labor by the experimental work of Parkes (14). He was of the opinion that the maximum effect of estrin on the uterus was exerted in from 36 to 48 hours after the last injection. We have chosen the onset of labor under 48 hours, following the last injection, as our basis for assuming that estrin might have been responsible for initiating labor in a particular case. Thus we feel that 8 of the 36 patients

might have been successfully started in labor following estrin administration. In the 8 patients who responded, the time interval between the last injection and the onset of labor varied from 10 to 46 hours. Two of these 8 patients were primipara and 6 were multipara. In these 8 patients who apparently responded the dosage employed was 10,000 international units in 2 cases, 20,000 in 1, 30,000 in 1, 50,000 in 2, and 100,000 in the 2 remaining cases. From these figures, it is interesting to note that the apparent response was not directly related to the amount of estrin administered. It is for this reason that we did not attempt a further series with larger doses of this drug.

We arbitrarily assumed that 10 hours was a short labor for a primipara. In this series there were 4 primipara in whom labor was completed in less than 10 hours. The length of labor in the 5 remaining primipara varied from 14 to 45 hours. We first attempted to classify short multiparous labors, but in reviewing the previous labor records of these patients, it was noted that a number had short labors without using estrin. Therefore, to prevent inaccurate conclusions, we dispensed with those data.

There were no general or local reactions following the intragluteal injection of estrin though one case of pre-eclampsic toxemia might prove to be an exception. Her symptoms and blood pressure were under control but upon receiving 50,000 international units of estrin, her blood pressure began to rise within 24 hours, and finally reached 200/140 within 72 hours. This naturally precluded the further administration of estrin and prompted us to induce labor by rupture of the membranes.

This case history is comparable to one quoted in the series of Robinson, Datnow, and Jeffcoate. Their patient, however, developed an eclamptic seizure. The postpartum course in our series was unaffected, and there were no postpartum hemorrhages. There were no harmful effects upon the babies, and no deaths can be attributed to the procedure. The age of the patient, parity, and gravidity were not found to be factors in the response to estrin induced labors.

¹Progeston B supplied through the courtesy of the Schering Corporation.

SUMMARY

It has been brought out that estrin can initiate and maintain uterine motility and contractility in animals and humans

Experimental evidence has been cited to show that pregnancy in certain animals can be terminated by estrin administration

We feel that the reports of successfully induced labor by estrin in the human are inconclusive. We are of this opinion because in practically all instances, estrin was employed along with other procedures or substances which might in themselves produce labor

We have attempted to induce labor near at and beyond term by administration of estrin without additional aid. Of 36 patients employed, it is possible that the onset of labor could have been attributed to the previously injected estrin in 8 cases. It is also possible that the estrin might have been responsible for the short labors in 4 of the 9 primiparæ in this series. The onset of labor bore no relationship to the dosage of estrin employed

Thus, our findings merely suggest the possibility that labor in the human near at, or beyond, term might be induced by estrin administration and that the duration of labor might be shortened by this method

We wish to express our appreciation to Dr. William C. Meagher for permission to carry out these studies and to Dr. S. R. M. Reynolds for his helpful criticism in the preparation of this report

BIBLIOGRAPHY

1. ASCHHEIM S and ZONDER B. *Klin Wchnschr* 1928 7 831

2. BOURNE A and BELL A C. *J Obst & Gynec Brit Imp* 1933 40 423
3. BOURNE W and BURN J H. *Lancet* 1928 216 1020
4. *Idem Lancet* 1932 1 1066
5. COHEN S L, MARRIAN G F and WATSON M. *Lancet* 1935 1 674
6. D'AMOUR and GUSTAVSON R C. *J Pharmacol & Exper Therap* 1934 51 353
7. DODDS I C and ROBERTSON J D. *Lancet* 1930 1 1390
8. FRAENKEL L and FELS E. *Deutsche med Wchnschr* 1927 53 2 154
9. CONNET J, BANSILLON E and BUCHER P. *Bull Soc d'obst et de gynéc* 1937 26 514-516
10. JEFFCOATE T N A. *J Obst & Gynec Brit Imp* 1932 30 67
11. KELLY C L. *Surg Gynec & Obst* 1931 52 713
12. KNAUS H. *Med Klin* 1934 30 1649
13. MÖLLER CHRISTENSEN and PEDERSEN BJERGAARD K. *Acta obst et gynec Scand* 1936 16 142
14. PARKES A S. *J Physiol* 1930 69 463
15. PARKES A S and BELLERBY C W. *J Physiol* 1926 62 145
16. REYNOLDS S R M. *Am J Obst & Gynec* 1935 29 630
17. *Ibid* 1937 33 968
18. *Idem Physiol Rev* 1937 17 304
19. REYNOLDS S R M and FIBOR W M. *Am J Physiol* 1926 62 145
20. *Ibid* 1933 104 311
21. ROBINSON A L, DATLOW M M and JEFFCOATE T N A. *Brit M J* 1935 1 749
22. RICE H, HARTMAN H and SIEVERS K. *Arch f Gynaek* 1932 149 608
23. SAVAGE J I, WYLIE H B and DOUGLASS L H. *Am J Obst & Gynec* 1938 36 39
24. SMITH C V and SMITH O W. *Am J Obst & Gynec* 1937 33 365
25. SMITH M. *Bull Johns Hopkins Hosp* 1926 39 203
26. SPIELMAN F, GOLDBERGER M and FRANK R T. *J Am M Ass* 1933 101 266
27. VORON J, BROCHIER A and CONTAMIN R. *Bull Soc d'obst et de gynéc* 1935 24 68
28. WITERSPOON J T. *Proc Soc Exper Biol & Med* 1932 29 1063
29. ZONDER B. *Die Hormone des hypophysen Vorder lapp u des Ovarium* 1930

PYELONEPHRITIC CONTRACTURE OF THE KIDNEY

FREDERICK LIFBETHAI, M D, Chicago, Illinois

A CHRONIC pyelonephritis may heal or it may go on, to terminate in a pyonephrosis or in a contracture of the kidney (pyelonephritic contracture). The earlier authors, among them J. Aschoff and W. Israel, believed the latter condition to be very rare. But Braasch in 1922 showed that it not infrequently occurs as the outcome of renal infection and reported 28 cases of his own. In fact this condition has not received the attention in the literature which it justly deserves. Staemmler believes that it occurs more frequently than secondary contracture due to chronic glomerulonephritis. In 1,000 autopsies he found 55 cases of renal contracture, 27 of which were due to arteriosclerosis or arteriolosclerosis, 18 to pyelonephritis, and only 3 to chronic glomerulonephritis.

Haslinger has also demonstrated that there are various transitions of pyelonephritic contracture to hydronephrosis and pyonephrosis, which if more carefully studied would be seen to belong in this group.

In its purest form, pyelonephritic contracture consists of a fibrous shrinkage of the kidney as the result of a chronic suppuration. The resulting organ is small and its surface is granular. These changes are limited to the kidney substance proper. The pelvis itself is relatively free from pathological change.

To insure the development of this final pathological picture, certain conditions are necessary. The chronic suppurative process must necessarily be incited by an organism of low virulence. Since a pyelonephritis caused by such an organism will usually heal promptly if the renal pelvis drains properly, an obstruction to the outflow of the urine from the pelvis is usually necessary for the maintenance of the chronic suppuration. This obstruction must also be of low grade. For if the obstruction is of a higher degree, the changes of a

hydronephrosis will precede and accompany those of the chronic suppuration and an infected hydronephrosis (large pyonephrosis) will result. If the infecting organism is one of high virulence, the suppurative process will not remain intratubular, but it will spread into the interstitial tissue, and form extensive abscesses and necroses in the renal substance. Coagulated plugs of fibrin and pus will plug the outlet from the renal pelvis and give rise to an empyema of the latter. The final picture will be that of a small pyonephrosis.

PATHOLOGY

Most suppurative processes in the kidney arise as the result of a descending infection. Because of the large caliber of the renal capillaries, bacteria which are circulating in the renal blood stream have a tendency to be carried out through the renal veins to lodge subsequently in the finer capillaries of the liver, the lungs, the bone marrow, and the spleen. The normal kidney does not excrete bacteria.

Infections of the renal substance may, however, occur either spontaneously or because certain conditions exist in the kidney which favor the occurrence of such an infection. If the organisms reach the renal capillaries not in a finely separated state but in clumps, small mycotic emboli may form in the finer end arteries which are situated mainly in the renal cortex. The resultant lesions are numerous cortical abscesses (nephritis aposthematosa). Such lesions, if not treated operatively (de-capsulation), may go on to suppurative destruction of the kidney, which is accompanied by a clinical course with high fever. Operative removal of the kidney may then become necessary to prevent a threatening septicopyemia. In other, more favorable, cases the abscesses rupture after a period of days or weeks into the renal tubuli, and this occurrence is followed by intratubular suppuration and the development of a typical acute pyelonephritis which may then heal spontaneously.

From the Division of Surgery (Department of Genito-urinary Surgery) of the Northwestern University Medical School.

In other cases, if an appreciable dissemination of virulent bacteria (especially cocci) occurs into the renal circulation small ne- croses may develop in the capillary loops of the glomerular tuft and through the resulting defects the bacteria may find their way mechanically into the glomerular lumina and thence into lumina of the renal tubuli. The organisms may then merely flow away with the urine (bacteriuria), or an intratubular sup- puration may follow (acute pyelonephritis). If renewed disseminations from a distant focus do not occur the process has a tendency to heal spontaneously.

If an obstruction to the outflow of the urine from the renal pelvis exists the kidney be- comes susceptible to infection. The stagna- tion of urine in the pelvis and the resultant stretching of the pelvic wall produce a reflex slowing of the circulation through the kidney. This gives circulating bacteria a greater op- portunity to lodge in the kidney. Further bacteria which have found their way into the tubuli and which ordinarily would be washed away with the urine now find an opportunity to remain in the stagnant urine there to mul- tiply and to produce infection. After an in- fection has occurred and intratubular sup- puration has developed the back pressure and lack of proper drainage serves to favor the maintenance of the process and to prevent healing. The intratubular suppuration may then continue for a period of months or even years. It is mainly with this latter type of chronic suppuration that we are concerned in cases of pyelonephritic contracture of the kidney.

In the early stages of chronic pyelonephritis the renal tubuli are seen to be packed with polymorphonuclear leucocytes. Then de- generative changes begin to appear in the tubular epithelium (Fig 7). At first there is an albuminous degeneration which may pro- gress through the various stages of vacuoliza- tion, hyalin droplet degeneration and finally to a necrosis and desquamation of the dis- integrated epithelial cells into the lumen of the tubule. These changes may occur along the entire extent of the tubular apparatus but they are usually most marked in the chief piece epithelium (proximal convoluted tu-

bules). This involvement occasionally also extends to the delicate epithelial membrane covering the glomerular tuft and manifests itself as a swelling of the nuclei of the tuft. These swollen nuclei are then identified as belonging to epithelial rather than to endo- thelial cells (of the glomerular capillaries) by the fact that the capillaries of the tuft are well filled with blood. The changes described occurring as a result of prolonged intratubular suppuration, may finally lead to a complete destruction and subsequent disappearance of the affected tubule (Figs 9 and 10).

As the suppurative process in the lumen of the tubule progresses it eventually leads to secondary inflammatory changes in the inter- stitial tissue. At first a narrow zone of poly- morphonuclear leucocytes appears around the periphery of the tubuli, especially in the medulla (Fig 7). Then scattered zones of small round cell infiltration and plasma cells appear in the interstitial tissue which spread and coalesce until finally the entire inter- stitial tissue is packed with a dense infiltration of round cells and plasma cells (Fig 8). This inflammatory change eventually leads to a fibrosis of the interstitial tissue which subse- quently shrinks (Fig 9). Hyalinization may also occasionally take place.

The arteries in these fibrosed areas show secondary pathological changes in the form of a massive thickening of their walls and a nar- rowing of the lumina mainly as a result of a thickening of the intima (Fig 13).

During the early stages of the process of contracture the glomeruli remain more or less intact. But they eventually undergo hyalin- ization partly as a result of inactivity atrophy after their corresponding tubuli have disap- peared and partly as a result of the ischemia caused by the secondary vascular changes de- scribed. This hyalinization progresses in a characteristic manner and begins in the parietal leaf of Bowman's capsule. A thin layer of hyalin appears under the epithelium gradually thickens and then spreads into the glomerular tuft at the hilus. Finally the entire glomerulus is converted into a hyalin sphere (Figs 10, 11, 12, and 13).

As the contracture of the renal tissue pro- gresses the interstitial inflammatory changes

gradually subside (Fig 9) It is at this time that localized groups of lymphoid cells appear in the interstitial tissue which on closer examination prove to be well developed lymph follicles with well defined germinal centers (Fig 14) In the normal kidney this lymphatic tissue appears in a rudimentary form as a delicate reticular stroma, which lies in the fibrous sheaths of the blood vessels and which is not demonstrable with the ordinary staining methods But under the stimulus of a chronic suppuration in the kidney this lymphatic tissue proliferates to form well developed lymphatic follicles Once they have appeared, these follicles persist, and they may remain long after all traces of the inciting suppurative process have disappeared

The intratubular suppuration may persist until the very end or it may also gradually subside The polymorphonuclear leucocytes then gradually disappear from the lumen of the tubuli With the disappearance of numerous renal tubuli, compensatory changes occur in those remaining The latter become dilated, their epithelium becomes flattened Occasionally finger like projections of epithelial cells sprout into the lumen The dilated tubuli not infrequently contain coagulated colloid (Fig 13)

The intratubular suppurative process sometimes causes a destruction of isolated segments of the tubule and the intervening portions remain temporarily intact The proliferating interstitial fibrous tissue then spreads in to close the gap At this stage the remaining tubular segment is seen in serial sections to terminate blindly at its proximal and distal aspects Retention cysts form not infrequently in this manner They are commonly seen in the form of obvious tubular segments which are dilated, in which the epithelium is flattened, and in which the lumen is filled with coagulated colloid Occasionally they may grow to the size of a pinhead, a match head, a pea, a cherry, or even larger (Fig 3)

GROSS PATHOLOGY

The shrinkage of the renal tissue may cause a varying reduction in the size of the organ The kidney on the one hand may be of almost normal size (Fig 3) and on the

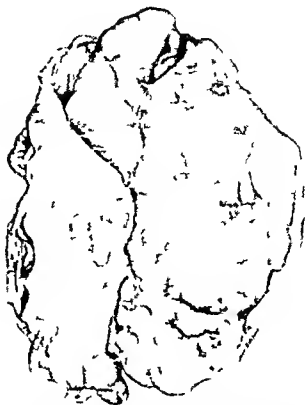


Fig 1 Pycelonephritic contracture The surface of the kidney is roughly granular with large uneven depressions and furrows The capsula propria which is reflected to the left is thickened, opaque and white

other may be 8 centimeters or even less in length (Fig 4) The capsula propria is usually whitish, opaque, and thickened, and somewhat adherent in spots to the underlying renal substance, from which it strips leaving a somewhat smooth, finely granular, or a roughly granular surface (Fig 1) The renal tissue itself is very firm and inelastic, and its cut surface reveals a pale yellowish, glassy hue The cortical and medullary markings are largely obliterated (Fig 2) The width of the cortex is greatly reduced and varies over different parts of the organ The medullary pyramids are usually very pale and sometimes show a whitish radial striation (fibrosis) The papillae may be greatly reduced in size Their surface is, however, usually smooth

The renal pelvis may be of normal size or slightly dilated The mucosa is usually normal in appearance Occasionally its surface is wrinkled (Fig 4) This is due to the fact that the shrinkage involves only the kidney substance proper and the pelvis subsequently accommodates itself to the latter

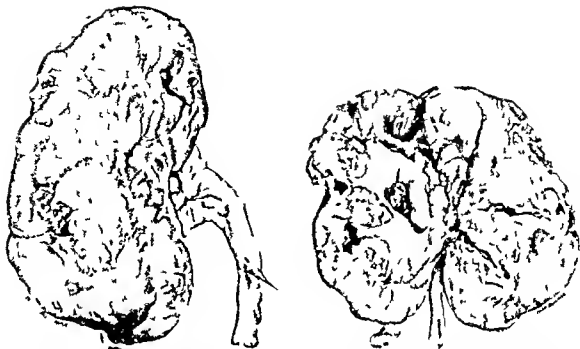


Fig. 2. Pyelonephritic contracture due to renal stone. a Left. Outer surface. The kidney is greatly shrunken and its surface is roughly granular. b Cut surface. The cut surface has a pale yellowish glassy appearance and is very firm in consistency. Cortical and medullary markings are obliterated. There is a proliferation of the peripelvic fat. The renal pelvis contains a small calculus.

Staemmler and Dopheide have described pathological changes on the renal papillæ and in the calyces in the form of an epithelial proliferation and thickening. *But these, in our opinion, are not a part of the picture of pure pyelonephritic contracture in which the surface of the papilla and the lining of the calyceal wall are perfectly smooth and unaltered.* The changes which the authors mentioned describe belong rather to those cases in which a transition to hydronephrosis or to pyonephrosis is developing. Thus in the presence of an associated beginning hydronephrosis the papilla may be slightly flattened and widened or cupped out. If a pyonephrosis is developing the surface of the papilla may reveal a fungus-like proliferation which on microscopic examination is seen to consist of necrotic tissue, which is fairly packed with bacteria—Bakterienrasen (Necker)—and which is the result of an infection by virulent organisms. In still other cases the surfaces of the papillæ and

the lining of the calyces have been converted into a thick, grayish to grayish yellow velvety coating. On microscopic examination this is seen to be due to a swelling and puffing up of the epithelial cells (foam cell membrane). Occasionally the surfaces of the papillæ and the lining of the calyces may assume a silvery glistening appearance due to a metaplasia of the lining epithelium which has been converted to a cornified epithelium. This is seen especially in those cases in which calculi are present in the pelvis.

A varying degree of perirenal and peripelvic fibrolipomatosis is usually present. The peripelvic fat spreads in from the hilus to fill the space defect caused by the shrinking of the renal substance.

In addition one frequently finds evidence of a low grade obstruction to the outflow of the urine from the renal pelvis. This may appear in the form of an aberrant vessel to the lower pole, a congenital valve at the uretero-

pelvic juncture, an anomalous insertion of the upper end of the ureter, or the presence of a pelvic calculus. It is also interesting to note the frequency with which fetal lobulation is demonstrable in cases of pyelonephritic contracture.

DIFFERENTIAL DIAGNOSIS

Pathologic differential diagnosis Pyelonephritic contracture is most frequently confused with renal hypoplasia. Other conditions in which shrinkage of the renal substance occurs may also resemble the contracted pyelonephritic kidney grossly.

Renal hypoplasia In this condition the kidney is usually very small as a result of incomplete development. This may manifest itself in a deficient development or absence of that portion of the renal anlage which comes from the nephrotom. The resulting kidney then shows a great sparsity or even a complete absence of glomeruli. In other cases the component parts of each nephron¹ are completely developed, but there is a decreased number of reniculi,² so that instead of 12 to 18 of the latter there may be only 2 or 3 (Fig 6). In renal hypoplasia the renal pelvis and ureter, as well as the renal blood vessels are usually small. Fetal lobulation is common.

But in spite of these differential points confusion may easily occur because infection and chronic suppuration are frequently present in hypoplastic kidneys. Further, kidneys which are not frankly hypoplastic but present congenital anomalies in the form of ectopy or of a pelvic malformation, are especially susceptible to infection and subsequent pyelonephritic contracture because of inadequate drainage of the renal pelvis. If, in addition, fetal lobulations persist, as often happens in such cases, one might very easily be misled into misinterpreting the resulting lesion as a renal hypoplasia.

In the later stages of pyelonephritic contracture, the suppurative process which has caused the damage may gradually burn out and disappear, leaving no trace of its previous



Fig 3 Pyelonephritic contracture. In this case the kidney is almost of normal size. The surface is smooth. The renal tissue is however very hard and inelastic. In the upper pole a large cyst is seen (indicated by arrow).

existence in the renal tissue (Case 2). The resulting kidney will be small, and its surface will be granular. Superficial gross and microscopic study will apparently reveal a renal hypoplasia. The tubuli will be free of polymorphonuclear leucocytes, and round and plasma cell infiltration will be absent from the interstitial tissue. But on more careful study the following facts will become evident. Although the kidney is small, there are a normal number of renal papillae. The renal pelvis is of normal size or larger, and merely seems smaller because its walls have become puckered in adjusting themselves to the shrinking renal substance. On microscopic examination the cortex is seen to be fairly packed with glomeruli in various stages of hyalinization (Fig 13). Careful study of the interstitial tissue will reveal occasional hyperplastic lymph follicles which bear mute evidence to the previous existence of a severe suppurative process in the kidney as illustrated in Figure 14.

¹The nephron is the complete individual secreting element consisting of a glomerulus with its corresponding tubular system.

²The reniculus consists of a renal papilla with its corresponding medullary pyramid and cortex.



Fig 4. Pyelonephritic contracture in a double kidney. a. Left. Outer surface. The kidney is very small. The surface is granular. b. Cut surface. There is a ureteral catheter in each ureter and pelvis. The renal substance is very narrow. Cortical and medullary markings are obliterated. Both renal pelvises are greatly wrinkled because they have had to accommodate them selves to the shrinking renal tissue.

Pyelonephritic contracture is most commonly confused with renal hypoplasia because both of these conditions are usually unilateral. But if the former is bilateral as may sometimes occur the occasion may arise at autopsy when a differentiation between this lesion and other bilateral forms of renal contracture notably renal arteriosclerosis (benign nephrosclerosis) and secondary contracture due to chronic glomerulonephritis may become necessary. Grossly the kidney may resemble one another in these three conditions. But since the intratubular suppuration persists in the great majority of cases of pyelonephritic contracture a casual glance through the microscope will usually immediately identify the lesion. It is only in those somewhat uncommon cases in which the underlying suppurative process has run its course and burned out months or years previ-

ously that confusion may arise. It may then be very difficult indeed to make a differential diagnosis.

Renal arteriosclerosis. This condition is always bilateral although the degree of involvement may vary on both sides. Hyalinization of glomeruli, secondary interstitial inflammatory change, and a disappearance of tubuli may occur here too and give rise to some confusion. But careful study will readily show sclerotic changes in the arterial blood vessels as the significant and underlying lesion. Further the hyalinization will seem to spread into the glomerular tuft from the hilus and it will not seem to begin in the peripheral leaf of Bowman's capsule as in pyelonephritic contracture. And here too the presence or absence of hyperplastic lymph follicles will tell us whether a severe suppurative process has preceded or not.

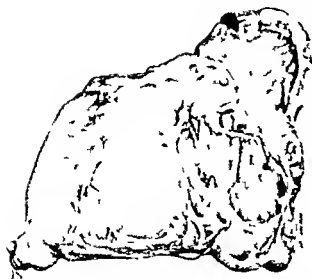


Fig 5 Infected hydronephrosis with pyelonephritic contracture

Secondary contracture due to chronic glomerulonephritis Here the demonstration of adhesions of the glomerular tuft to the peripheral leaf of Bowman's capsule and the presence of half moon forms on the latter will usually bear testimony to the previous existence of inflammatory changes in the glomeruli. But in the advanced stages of contracture the differentiation may be exceedingly difficult, and only the presence or absence of hyperplastic lymph follicles will tell us which condition we are dealing with.

Finally, it must not be forgotten that mixed forms may occur, in that chronic suppuration and subsequent contracture may develop in a kidney in which other pathological changes are already present. Thus, for example, an old man with renal arteriosclerosis may, as the result of a bladder neck obstruction, due to a prostatic hypertrophy, develop a chronic bilateral pyelonephritis, which may lead to further contracture of the kidneys.

SYMPTOMS

The patient may complain of a dull ache in the renal region or subjective symptoms may be absent. Pyuria is usually present, but in the later stages of the disease the urine may be perfectly clear. Not uncommonly the contracted pyelonephritic kidney is symptomatically silent, and it may then appear as a chance finding at the autopsy table.

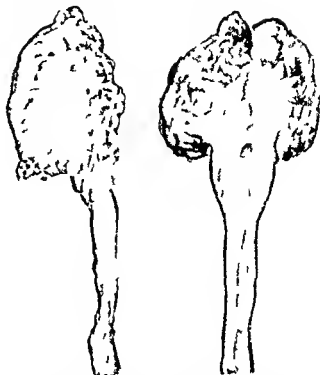


Fig 6 Renal hypoplasia. The kidney measures 2 centimeters in length. There are only three renal papillae all of which are imperfectly formed. The renal pelvis is small. Autopsy specimen.

Occasionally pyelonephritic contracture is bilateral. The general symptoms of total renal insufficiency then make their appearance. The urine is of low specific gravity and increased in quantity, and it may contain occasional hyalin or granular casts. Albumin may be sparingly present or absent. The blood pressure is usually elevated, and blood chemistry studies reveal a retention of nitrogenous products. The final clinical picture is that of a uremia in bilateral cases.

The recent clinical studies of Barker and Walters, Leadbetter and Burkland, Boyd and Lewis, and of others, inspired by the experimental investigations of Goldblatt and his coworkers, have shown that unilateral pyelonephritic contracture may cause a hypertension which is cured by nephrectomy.

DIAGNOSIS

The most important diagnostic finding is that of a marked functional defect in the involved kidney. The separated urine from this organ may contain pus cells and bacteria, but in the later stages of the condition it may be perfectly clear. It is, however, very pale and

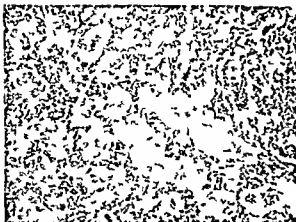


Fig. 7 Beginning pyelonephritic contracture. High power photomicrograph showing severe degenerative changes in the epithelium of the renal tubuli and surrounding zones of polymorphonuclear leucocytic infiltration.

of low specific gravity. These findings may coincide exactly with those of renal hypoplasia. Pyelography however makes a differential diagnosis possible. In pyelonephritic contracture the renal pelvis is of normal size and form or it may be somewhat dilated. In renal hypoplasia the kidney pelvis is smaller than normal and imperfectly developed.

In those cases in which the pyelonephritic contracture is bilateral the symptoms may coincide exactly with those of chronic glomerulonephritis with contracture, except that



Fig. 9 Low power photomicrograph showing fibrosis of the interstitial tissue. The cellular infiltration is already subsiding.



Fig. 8 High power photomicrograph showing extensive round and plasma cell infiltration of the interstitial tissue.

pyuria is usually present in the former. But if the suppurative process has run its course and burned out the urine may be clear. It may then be impossible to make a differential diagnosis antemortem. In fact the possibility of a bilateral pyelonephritic contracture is rarely suspected in such instances and a diagnosis of chronic glomerulonephritis with contracture is practically always made. Even at autopsy the error may persist unless a very careful microscopic study is subsequently carried out.

SPECIMEN CASES

CASE 1 Patient complained of left lumbar pain of 6 months standing and frequency of urination of 6 months standing. Physical examination revealed a somewhat undernourished white female of about 30 years of age. Neither kidney was palpable but there was definite tenderness in the left costo vertebral angle.

Urinalysis revealed color turbid, specific gravity 1020, albumin trace, sugar negative. Microscopic examination showed urine to be loaded with pus cells. Gram stain revealed many gram negative intracellular diplococci morphologically resembling *Gonococci*.

Cystoscopic examination showed that the bladder capacity was normal, the right ureter orifice appeared to be normal, the left orifice was edematous and a tooth paste like ribbon of pus exuded. From right kidney indigocarmine intensive blue appeared in 7 minutes, no pathological elements were noted. Left ureter could not be catheterized, no color was seen in 15 minutes.

Diagnosis: Left gonorrheal pyonephrosis. Left nephrectomy was done and postoperative course was uneventful.



Fig. 10 Low power photomicrograph showing hyalinization of parietal leaf of Bowman's capsule of the glomeruli. The tubuli have largely disappeared from the interstitial tissue which is the seat of a small round cell infiltration.

Pathology. The left kidney measured 5 by 3 by $2\frac{1}{2}$ centimeters. The capsule which was somewhat thickened whitish and opaque stripped readily leaving a roughly granular pale surface upon which fetal lobulations were still evident. The kidney was very firm and inelastic in consistency. The cut surface was pale and had a somewhat glassy hue. The cortex was greatly narrowed and granular in appearance. Several pin point sized whitish spots were seen in the cortex at the upper pole (pyelonephritic abscesses). The papillae were flattened. The pelvic lumen contained a thick greenish yellow pus. The pelvic mucosa was wrinkled and numerous pinhead sized opaque nodules bulged from its surface (granular pyelitis).



Fig. 11 High power photomicrograph showing hyalinization of parietal leaf of Bowman's capsule.

Microscopic examination revealed most of the glomeruli in various stages of hyalinization. There was considerable round cell infiltration in the interstitial tissue and numerous hypertrophic lymph follicles with well defined germinal centers were evident.

However, the tubuli seemed to be decreased in number. Most of the remaining tubuli were filled with polymorphonuclear leucocytes and amorphous debris. The epithelial cells revealed a severe albuminous degeneration. A few of the tubuli were dilated, their epithelial cells were flattened, and their lumina were filled with coagulated colloid.

Pathologic diagnosis: pyelonephritic contracture of the kidney.



Fig. 12 The above illustration is a high power photomicrograph showing three stages in the hyalinization of the glomerulus. At A the hyalinization is seen confined to the parietal leaf of Bowman's capsule which is greatly thickened. At B the hyalin is spreading into the tuft. Finally at C the glomerulus has been converted into a hyalin sphere.



Fig. 13 High power photomicrograph showing the end stage of pyelonephritic contracture. All traces of intratubular suppuration as well as most of the interstitial inflammatory change have disappeared. The glomeruli have been converted into hyalin spheres. The few remaining tubuli are filled with coagulated colloid. The arterial blood vessels are greatly thickened (indicated by arrows).



FIG. 14. High power photomicrograph showing a type I, a tubercle made with a well defined central necrosis.

CASE 10.—On admission an patient complained of a kicking pain in the left loin of a month's duration and frequency of urination. Physical examination revealed a 35-year-old female with slight tenderness in the left loin-vertebral angle. No kidney was palpable nor tender.

Cystoscopic examination revealed normal bladder apparatus. The mucosa was dull red. The right ureteral orifice was normal. The left orifice was capricious and drawn up. Catheters were passed in both sides. From the right indigo appeared in 3 minutes; was intensive blue in 5 minutes. No pathological elements were noted. From the left indigo appeared in 3 minutes; blue in 5 minutes. In 3 minutes of cystoscopy papillae and papillae colic were noted. Cystoscopic examination revealed a week later showed from right indigo intense blue in 3 minutes. No pathological elements noted. From left indigo

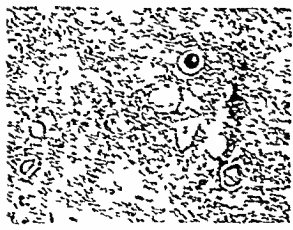


FIG. 15. Renal hypospadias. The tubules are dilated and show brown discoloration. There is complete absence of elements. High power photomicrograph.



FIG. 16. High power photomicrograph showing hyperplasia of the tubules and a renal blood vessel in a case of pyelonephritis, low magnification.

ble but no increase in minutes of papillae and tubules colic noted. During the 3 months following the urine had progressively become less pungent but the left lumbar pain had persisted.

Cystoscopic examination revealed a normal bladder capacity. The trigone was reddened. The right ureteral orifice was normal. The left orifice was capricious. The right ureter was catheterized. On the left the catheter would not enter. From the right side indigo excretion visible appeared in 3 minutes. No pathological elements were noted. From left no action so coloration not noted. The bladder urine on a red bacilli coli and only an occasional papillae.

Nephrography revealed a left renal pelvis of normal size. There was a slight dilatation of the terminal regular.

Left nephrectomy was performed.

Pathology.—The kidney measured 11 by 4 by 2 centimeters. The capsule which was somewhat thickened white and opaque showed readily leaving a granular surface. The cut surface revealed an abundant mass of the cortical and medullary markings. The renal substance varied in thickness from 1 to 1.5 centimeters. The pelvis, lower calyx and no pelvis and the pelvis masses was somewhat normal except for a swelling of the calyx.

Microscopic examination revealed the glomeruli somewhat crowded. A few were completely hyaline but most of them were in various stages of thickening and a hyaline wall of the parietal leaf of Bowman's capsule. In many cases the nuclei of the tuft appeared smudged (these were probably of epithelial cells because the capillary lumen were well filled with blood). The renal tubules seemed to have decreased greatly in number especially in the medulla. The chief pieces of the remaining tubules revealed an extensive albuminous and hyaline degeneration. Some of these tubules were dilated and their lumina were lined with thickened colloid

There was an extensive round cell infiltration of the interstitial tissue

Pathologic diagnosis pyelonephritic contracture The kidney undoubtedly underwent a shrinkage between the first and last examinations During this period the infection was gradually subsiding

CASE 3 Patient complained of frequency of 6 months' duration and pyuria Physical examination revealed a moderately well developed male of about 26 years Neither kidney was palpable or tender

Urine examination revealed color cloudy specific gravity, 1020, albumen trace sugar, negative Microscopic examination showed that the urine was loaded with pus cells Gram stain disclosed *Bacillus coli*

Cystoscopic examination showed a normal bladder capacity The mucous membrane was redened The left ureter orifice was normal In the region of the right ureter orifice a large diverticular orifice was visible The ureteral orifice itself could not be seen and apparently opened into the diverticulum A ureteral catheter was passed on the left The right orifice could not be catheterized From the right no color was seen in 15 minutes From the left indigo, intensive blue appeared in 5 minutes No pathological elements were noted

A cystogram revealed a walnut sized diverticulum on the right side of the bladder

An intravenous urogram revealed normal concentration and normal contours of the left renal pelvis The appearance of the dye was delayed on the right The renal pelvis and ureter were greatly dilated

Diagnosis diverticulum of the urinary bladder, infected by hydronephrosis right A right nephrectomy was done

Pathology The kidney proper measured 6 by 3 by 3 centimeters The capsule was thickened, gray and opaque and stripped with some difficulty leaving a coarsely granular surface On the cut surface the kidney substance was seen to be less than $\frac{1}{2}$ centimeter in thickness It was somewhat pale and glassy in appearance and rather firm in consistency The pelvis was enormously dilated and contained about 120 cubic centimeters of slightly purulent fluid The calyces were widened and shortened The papillae were flattened and cupped out

Microscopic examination revealed the glomeruli closely grouped and in various stages of hyalinization The interstitial tissue especially in the cortex contained very few tubuli and was the seat of an extensive round cell infiltration The remaining tubuli were dilated This dilatation was more marked in the medulla Most of the tubuli contained numerous polymorphonuclear leucocytes A few tubuli were, however, filled with coagulated colloid In the interstitial tissue numerous well developed lymph follicles with well defined germinal centers were to be seen

Pathologic diagnosis Infected hydronephrosis with pyelonephritic contracture

CASE 4 Patient had suffered with left lumbar

pain for 1 year Physical examination revealed a well developed male of about 35 years of age, apparently not acutely ill

Cystoscopic examination revealed the urine cloudy the bladder mucosa and the ureteral orifices revealed no abnormalities, catheters were passed on both sides From right the indigo appeared intensive blue in 7 minutes No pathological elements were noted From the left the indigo was light blue in 15 minutes Many pus cells and red blood cells were noted

X-ray examination The flat plate revealed a staghorn calculus in the region of the left renal pelvis Pyelography revealed a slight dilatation of the renal pelvis and of the calyces

A left intracapsular nephrectomy was done

Pathology The kidney was of normal size The surface was finely granular and glistening On the cut surface the parenchymal markings were well seen The renal substance, however, had a yellowish, glossy hue and was very hard on palpation A large staghorn calculus filled the renal pelvis

Microscopic examination showed considerable albuminous and some hyalin droplet degeneration of the chief piece epithelium The tubuli seemed to have decreased in number and there was considerable fibrosis and hyalinization of the interstitial tissue especially in the medulla A few of the tubuli contained scattered groups of polymorphonuclear leucocytes Numerous areas of rather dense round cell infiltration appear in the interstitial tissue Well defined follicles of lymphoid tissue with well defined germinal centers were also seen Some of the glomeruli showed a beginning hyalinization The hyalin appeared in a thin layer under the epithelium of the parietal leaf of Bowman's capsule and in small clumps in the tufts

Pathological diagnosis staghorn calculus with beginning pyelonephritic contracture of the kidney This represents a pyelonephritic kidney in the stage of beginning contracture The ascending intratubular infection has already largely burned out The interstitial inflammatory change now commands the field The tubuli have begun to disappear and hyalinization of the glomeruli with interstitial hyalinization is beginning

CASE 5 Patient had been hospitalized for a tuberculous hip During this time pus cells and bacteria (*Bacillus proteus*) were found in the urine Subsequently (during the past 3 weeks) she developed severe sticking pains in the right lumbar region Physical examination revealed a well developed female of about 25 years of age

Cystoscopic examination revealed cloudy urine, bladder capacity, normal, the mucous membrane slightly reddened Catheters were passed on both sides From right indigo carmin, light blue, appeared in 8 minutes 6 to 8 leucocytes were noted as well as the *Bacillus proteus* From left indigo intensive appeared in 4 minutes No pathological elements were noted

Nephrectomy was performed

Pathology The kidney was of normal size. The capsule stripped readily leaving a smooth surface of pale yellowish hue. The cut surface had a slightly glassy hue. There was an obliteration of the cortical and medullary markings and the renal substance was hard and inelastic in consistency. The pelvis and ureter revealed no abnormalities. Two small urate stones appeared one in a lower calyx.

Microscopic examination disclosed very few tubuli. There was considerable interstitial round cell infiltration. In the few remaining tubuli the epithelial cells were necrotic and in many places desquamated into the lumen in which a few polymorphonuclear leucocytes could still be seen. Most of the glomeruli revealed a swelling of the nuclei of the tuft and a poor filling of the capillary loops. In many there was a beginning hyalinization of the parietal leaf of Bowman's capsule.

Pathologic diagnosis renal stone with pyelonephritic contracture of the kidney.

CASE 6 Five months previous to admission the patient complained of abdominal cramps followed by jaundice. This subsequently cleared up and she was well for 2 months. Then there were several recurrences of the cramps which were always in the epigastric region. During this time she lost 30 pounds in weight. A complete medical examination was negative except for the finding of a few pus cells in the urine and a small calcific shadow in the region of the left kidney.

Cystoscopic examination showed the urine cloudy, the bladder essentially normal. Catheters were passed on both sides. From right indigo intensive blue appeared in 6 minutes. No pathological elements were noted. From left indigo very pale blue appeared in 15 minutes many leucocytes were noted. A ray examination revealed a calcific shadow the size of an almond in the region of the left renal pelvis. Pyelography revealed a slight dilation of the pelvis and of the calyces.

A left intracapsular nephrectomy was done.

Pathology The kidney measured 8 by 4 by 3 centimeters. The surface was roughly granular and showed irregular bumps. Where the capsule was stripped (at operation) the renal substance was adherent in places and tore. On the cut surface the kidney appeared slightly paler than normal and granular and very firm on palpation. The cortex was very narrow (1 to 2 millimeters) and of irregular thickness. The pyramids were dark red with longitudinal whitish lines (fibrosis). The papillae were smaller than normal but smooth. The pelvis was white and marbled but smooth and contained a black rough stone the size of a shelled peanut. There was an increase in the peripelvic connective tissue which was harder and more yellow than normal.

Microscopic examination disclosed that the glomeruli appeared closely packed and some of them showed a beginning hyalinization. The medullary tubules were dilated and there was considerable interstitial medullary fibrosis. There was also a

marked round cell infiltration of the interstitial tissue from which many of the tubules seemed to have vanished. Some of the remaining tubules still contained groups of polymorphonuclear leucocytes.

Pathological diagnosis renal stone with pyelonephritic contracture of the kidney.

SUMMARY

1. Pyelonephritic contracture consists of a shrinkage of the renal substance as a result of chronic suppuration.

2. The condition is rather common.

3. Various transitions to hydronephrosis and pyonephrosis are frequently seen.

4. Its development in a pure form depends upon the presence of a low grade suppuration and usually of a low grade obstruction. It is therefore not uncommonly seen in cases of pelvic calculus.

5. It is most frequently confused both clinically and pathologically with renal hypoplasia.

6. Pyelonephritic contracture is usually unilateral.

7. The most important diagnostic finding is that of a marked functional defect in the involved kidney. The pyelogram reveals a pelvis which is of normal size or slightly dilated.

8. Pyelonephritic contracture is occasionally bilateral. The symptoms may then resemble those of chronic glomerulonephritis with contracture.

9. Unilateral pyelonephritic contracture may cause a hypertension which may be relieved by nephrectomy.

REFERENCES

1. ALLEMANN, R. Zur Chirurgie der Doppelnieren. Zugleich ein Beitrag zur Histologie der pyelonephritischen Schrumpfnieren. Deutsche Zeitschr. f. Chir. 1932 238 225-238.
2. BARBER, V. W. and WALTERS, W. Hypertension associated with unilateral chronic atrophic pyelonephritis: treatment by nephrectomy. Proc. Staff Meet. Mayo Clin. 1938 13 118-121.
3. BOYD, C. H. and LEWIS, L. G. Nephrectomy for arterial hypertension. J. Urol. 1938 39 627-635.
4. BRASCH, W. F. Atrophic pyelonephritis. J. Urol. 1922 7 247-257.
5. GOERBRANDT, I. Histologische Untersuchungen ueber die Beteiligung des Nierenbeckens bei Erkrankungen der Niere. Arch. f. Path. etc. 1926 250 269.
6. HASLINGER, K. Die pyelonephritische Schrumpfniere. Zeitschr. f. Urol. Chir. 1928 24 1-83.
7. ISRAEL, J. and WILHELM, W. Chirurgie der Niere und des Harnleiters. Leipzig: George Thieme 1925.

- 8 JACOB MAX Ueber Lymphgengereaktionen an Niere und Harnwegen und ihre Beziehungen zu lokalen Entzündungsprozessen *Ztschr f Urol* 19 7 31 241-261
- 9 Idem Beitrag zur pyelonephritischen Schrumpfmiete *Ztschr urol Chir* 1930 29 390-401
- 10 KAPFMEIER G III Kongr der Deutsch Gesellsch Urol 1911
- 11 LEADBETTER W F and BURLAND CARL Hyper tension in unilateral renal disease *J Urol* 1938 39 611-626
- 12 LONSCOPE W T and WINKERWELDER W I Clinical features of contracted kidney due to pyelonephritis *Bull Johns Hopkins Hosp* 1933 53 255-287
- 13 SCHMUTTL Zur Hypoplasie der Niere *Ztschr f urol Chir* 1929 28 284
- 14 STAEHSELER M and DOPPEL W Die pyelonephritische Schrumpfmiete *Arch f path Anat* etc 1930 277 713-756
- 15 STAEHSELER M Ueber pyelonephritische Schrumpfmiete *Muenchen med Wchnschr* 1932 79 2005

CARCINOMA OF THE BREAST

End-Results Massachusetts General Hospital 1930, 1931, and 1932

CHAYNING C SIMMONS MD FACS, GRANTLEY W TAYLOR MD FACS,
and CLAUDE E WELCH MD, Boston, Massachusetts

THE following paper is the seventh in a series of communications reporting the end results of operation for carcinoma of the breast performed at the Massachusetts General Hospital, and covers cases treated during the 3 year period, 1930-1932 inclusive. Both private and ward patients are considered, and this report has been arranged, in so far as possible, in the same manner as the former reports in order that results may be compared with the previous findings.

Evaluation of therapy obviously must depend upon careful end result studies, and in malignant disease a protracted period of observation is necessary before reliable conclusions can be reached. Likewise accurate knowledge of the life history of the disease offers an invaluable control in appraising the results of treatment. The studies of Daland on untreated carcinoma of the breast are of inestimable value in contributing to our knowledge of carcinoma of the breast, as is also the recent report of Nathanson and Welch on life expectancy and incidence of the disease. Proper use of the curves presented by these authors may permit tentative appraisals of the results of a method of treatment before the arbitrary 5 year follow up period has elapsed, as suggested by Meigs.

The first report in our series from the Massachusetts General Hospital (5), published in 1907, was based on a minimum 3 year follow-up period. Subsequent reports (3, 4, 6, 10, 11) have been based on a 5 year follow up period. It is recognized that this is a purely arbitrary interval, and that a certain number of recurrences will take place after an apparent 5 year "cure." However, the attempt to follow cases for a longer period in a general hospital clinic is very difficult and the increase in untraced patients tends to vitiate data based on a longer follow up period.

It will be observed that each series of cases we have studied has shown improvement in results when compared with previous series. If at any time we had instituted any new adjunct to our method of treatment, the conclusion would be inevitable that the increased number of cures was due to the added factor. Two factors certainly have been effective in improving our results, namely, improved surgical technique and better selection of cases suitable for attempt at operative cure. The formation of a Tumor Clinic at the Hospital, and the assignment of cases of carcinoma of the breast for special study to members of the Tumor Clinic staff led to a standardization of operative technique in a radical operation (13). Intensive study, especially of results of

operation, led to a clarification and restriction of operability.

However, it is probable that a large part of the improvement shown in the results of surgical treatment in recent years has been due to a more careful selection of cases suitable for surgical intervention, and a greater reluctance to employ surgery in conditions in which experience has demonstrated that surgery is useless or prejudicial. Many patients have been saved an operation following routine x ray studies of the chest and skeleton with the detection of metastatic foci in cases which might otherwise be assumed to be operable. The availability and effectiveness of radiation therapy as a palliative procedure in borderline and poor risk patients has also sharpened the criteria of operability.

It is impossible to determine how much of the improvement in the results of operation may be attributable to the campaign of cancer education carried out in the past 13 years by the American Society for the Control of Cancer, the American College of Surgeons and the Massachusetts Department of Public Health. In spite of the narrowed criteria of operability, the operability of patients with carcinoma of the breast at the Massachusetts General Hospital remains at about 80 per cent of admissions. A considerable but undetermined number of patients are intercepted in the Out Patient Department and treated for inoperable carcinoma without admission to the Hospital and it is also probable that physicians refer patients to the hospital that seem to them to be favorable for cure, while their patients with advanced conditions are referred to some of the more recently established radiological institutions for palliative treatment hence our 80 per cent operability.

OPERABILITY

Carcinoma of the breast is operable when the disease is confined to the breast or to the breast and axilla. The primary tumor must be movable in relation to the chest wall and must not present extensive skin involvement, skin metastases, or the subepidermal infiltration known as inflammatory carcinoma. The axillary nodes must be movable in relation to the chest wall and great vessels and

these nodes must be few in number. There must be no evidence of disease in the supraclavicular areas or in the opposite axilla, nor of metastatic disease in the lungs, pleura, liver, or skeleton. Patients in the last 2 series have had pre-operative x ray studies to rule out the presence of skeletal and pulmonary metastases.

Comparison with results achieved in other clinics must be made with caution and reservation. In analyzing the cases, we have employed the abstract record sheets advocated by the American College of Surgeons and have adopted their classification. If these sheets were in general use it would simplify the comparison of various methods of treatment of malignant disease. An attempt to broaden the field of operability may result in an occasional cure but only in a marked falling off in percentage of cures. On the other hand rejection of cases with palpable axillary lymph nodes would result in a marked apparent improvement in percentage of cures by denying to a considerable group the possibility of surgical intervention.

As a matter of fact in certain clinics the hope has been entertained that by means of pre-operative x ray therapy cases primarily inoperable, would be rendered operable, and that hence the benefit of radical surgery could be offered to more advanced lesions. Investigation of this possibility is a legitimate field for clinical study. We have not employed this procedure in any of the cases in this series. The improvement in our statistics cannot be due to the combined treatment by surgery and radiation for pre-operative radiation was not employed in any case, and relatively few patients received postoperative prophylactic radiation. This fact is significant in comparing these results with those obtained by other observers who suggest that the improvement in their statistics is due to the employment of radiation therapy in conjunction with surgery. In recent years there has been a tendency in some clinics to carry out less than radical operations in certain selected cases. Since clinical appraisal of the extent of the disease especially as regards axillary lymph node involvement, is highly fallible we can entertain no sympathy for this practice.

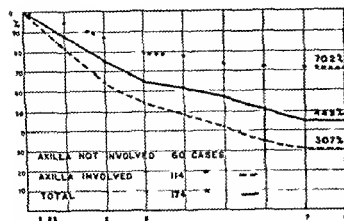


Chart 1. Percentage of cures at yearly intervals in carcinoma of breast on the basis of axillary involvement

ANALYSIS OF CASES

The group represents the cases seen in the General Hospital, the private wards, and the semi private wards. Operation with the hope of cure was performed during this 3 year period on 185 patients divided as follows: General Hospital, 73, private wards, 43, semi private wards, 69. The end result is known in every case.

The Tumor Clinic was in charge of all the patients operated upon in the General Hospital and these patients were operated upon by members of the Tumor Clinic staff, and a large proportion of the patients in the private wards were operated upon by the same group of surgeons. Thus 134 of the operations were performed by members of the Tumor Clinic staff and 51 by 17 other surgeons, only 2 of whom performed more than 5 operations in the 3 year period studied.

In the analysis of the cases, we have followed the same rules adopted in the previous reports. Operative deaths are considered as failures. Patients dying with recurrence after 5 years or patients living from 5 to 8 years with recurrence are considered as "dead of disease." Untraced patients, of whom there are none in this series, are also considered as having died of recurrence. Patients dying of other causes, such as appendicitis, within 5 years from the date of operation are excluded as inconclusive.

The same type of operation was performed by all members of the Tumor Clinic staff and those performed by other surgeons varied only in unessential details. The radical operation

TABLE I — 185 PRIMARY OPERABLE CASES

	Cases	Cases
Disease limited to the breast	69	
Died without recurrence less than 5 years	9	
Suitable for study		60
Disease limited to breast and axilla	116	
Died without recurrence less than 5 years	2	
Suitable for study		114
Total cases for end result study		174

consisted of the removal of the breast, both pectoral muscles and the contents of the axilla. A large amount of subcutaneous tissue extending from the sternum to the border of the latissimus dorsi was removed but enough skin was preserved to allow closure in most instances. That this procedure was justified is shown by the fact that in the 133 cases in which we have data there was a recurrence in the region of the wound in only 10 cases (7.6 per cent).

Of the 185 patients with carcinoma of the breast suitable for an attempt at cure by radical operation admitted to the hospital during the 3 year period, the disease was limited to the breast in 69 cases (37 per cent) and in 116 the axilla was involved. Eleven patients died of other disease within 5 years from the date of operation and have been excluded as inconclusive in studying the end results.

Of the 174 cases available for end result studies 78 or 44.8 per cent are living without evidence of disease from 5 to 8 years after operation. All cases have been followed for 5 years after operation and many of them for 6 to 8 years. Five years after operation 56.3 per cent are living. This figure is compared with those obtained in the previous groups studied: Percentage of cures, 1894-1904, 19, 1911-1914, 27, 1918-1920, 30, 1921-1923, 35, 1924-1926, 41, 1927-1929, 43, 1930-1932, 45. The percentage of cures in the cases in which the disease was limited to the breast was 70.2 but if the axillary lymph nodes were involved the percentage of cures was only 30.7. The figures obtained in the 1927-1929 group previously reported were 74.8 per cent and 24 per cent respectively. In general it may be said that if the disease is limited to the breast the chances of surgical cure are 3 out of 4, and if the axillary nodes are involved, 1 in 4.

TABLE II—DURATION OF DISEASE—RESULTS

Pre-operative duration—months	% patients living	% patients died	Cure percentage
Less than 1	11	14	44
1 to 3	20	21	49
4 to 6	10	15	40
7 to 12	10	23	43
13 to 24	8	6	57
25 to 36	1	4	20

(Data on 133 cases)

The percentage of survivals at yearly intervals is shown graphically in Chart 1

Operative mortality. There were 3 deaths at tributable to the operation—an operative mortality of 1.6 per cent. One death was due to cardiac failure, one patient died as the result of sepsis, and 1 from pneumonia and dementia.

Duration of disease and results. In the present series there was slightly less delay from the time the tumor was first noticed to the time of operation than in the previous groups studied. The average pre-operative duration in the cases in which the disease was limited to the breast was 2.8 months, and in the cases in which the disease had extended to the axilla 3.3 months. The figures imply that patients are seeking advice for a suspicious tumor of the breast at an earlier date than formerly.

As previously stated the duration of the disease before operation in a large series of cases apparently has little relation to the results of treatment, but it is important in the individual case (Table II). The prognosis has always been found to be worse when the disease is of short duration if the cases are studied as a group. This may be explained in part at least by the fact that the more malignant tumors are of rapid growth and attain a size which causes the patient to seek medical advice relatively quickly. The percentage of cases in which the disease was confined to the breast was less than in the last 7 groups studied. It was interesting to note that in the patients in the private wards the percentage of cases in which the disease was confined to the breast alone as well as the number of cases of low malignancy was greater than in the general hospital. The figures are not conclusive but suggest that the social status of the patient may have some relation to the disease. This possibility has been suggested by several authors.

TABLE III—AXILLARY NODES

	Positive No.	Percentage	Negative No.	Percentage	Total cases
Palpable	53	87	8	13	61
Not palpable	47	53	3	21	9

Extent of disease—results. The extent of the disease that is whether it is limited to the breast or whether it has extended to the axilla is apparently the most important single factor influencing the result of operation. Although the pre-operative duration of the disease was less in this series than in previous series, the percentage of patients with positive axillary nodes was greater. The percentage of cases limited to the breast is as follows: 1894-1904 33, 1911-1913 31, 1918-1921 30, 1921-1923 28, 1924-1926 41, 1927-1929 38, 1930-1932 37. In the patients in the private wards the disease was confined to the breast in 53.5 per cent while in the general hospital only 35.3 per cent were in this group. In the semi-private wards where the patients represent an intermediate social group the disease was limited to the breast in only 29 per cent of the cases.

Data as to the presence or absence of clinically palpable axillary nodes were available in 140 cases. In the 61 cases in which nodes were noted on physical examination positive evidence of cancer was found in 53 (87 per cent) on microscopic examination of the specimen. In the 79 cases in which no axillary lymph nodes could be felt, cancer was found on dissection of the axilla in 37 (46 per cent) (Table III).

Pathology. Since Broder's paper was published in 1923 on the grading of malignant tumors and the relation of the degree of malignancy to the prognosis we have graded all tumors placing them in 3 groups instead of 4. The grade of malignancy has been found to have a definite bearing on the prognosis. It is more difficult to grade an adenomatous than a squamous cell tumor and although there was some difference of opinion among pathologists they agreed as to the grade in most instances. The criteria employed were (1) the amount of differentiation of the cells that is the tendency to form glands and evidence of secretion, (2) the uniformity in size and shape of the nuclei, (3) the number of mitoses, and (4) the tendency of the cells to infiltrate

That this grading is of distinct value in making a prognosis has been shown in the previous papers and is borne out in the analysis of this group. The grade of malignancy is second only to the extent of the disease in determining the prognosis in a given case. The majority of the cases fall in Group 2. There were relatively few cases of low malignancy (Group 1) but a larger percentage were in the group of high malignancy than was the case in the previous series.

There were 19 cases in the low malignancy group. One was an operative death and 3 patients died of other diseases within 5 years from the date of operation and are therefore inconclusive. Of the 15 remaining patients, 13 are living without disease and are classed as cures (86 per cent). The axillary nodes were involved in only one of the 19 cases. Fifteen cases were classed as grade 1, 14 of these patients (93.3 per cent) showed no extension of the disease to the axillary nodes.

Eighty-five cases were classed as grade 2 with 51 per cent cures. The disease was limited to the breast in 26 patients, or 30 per cent of the cases in this group. Seventy-one cases were classed as grade 3. There were 31 per cent cures and in 18 patients, or 25 per cent, the disease was confined to the breast.

The percentage of cases in the 3 grades of malignancy living at yearly intervals is shown graphically in Chart 2. In making this chart the 3 cases dying as the result of operation have been excluded. There were 5 cases of Paget's disease of the nipple. One patient died of other disease within 5 years, 2 died of recurrence and 2 are well. There was also 1 case of squamous cell cancer in which the tumor was deeply situated in the breast. This patient died from metastases.

The tumors of high malignancy were more common in the younger age group, but tumors of low malignancy did occur and in these the prognosis was as favorable as tumors of the same degree of malignancy occurring in older patients. In other words, the prognosis depends on the degree of malignancy and not on the age of the patient as is often stated. The manner in which we classified 174 cases as to age and degree of malignancy is as follows. There were 29 cases in the age group

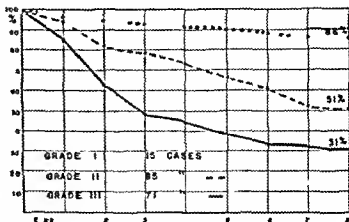


Chart 2. Percentage of cures at yearly intervals in carcinoma of breast on the basis of the pathological index of malignancy.

18 to 40 years, with grade 1, 3 per cent, grade 2, 42 per cent, grade 3, 55 per cent. There were 91 cases in the age group 41 to 60 years, with grade 1, 11 per cent, grade 2, 48 per cent, grade 3, 41 per cent. There were 51 cases in the age group 61 to 80 years, with grade 1, 8 per cent, grade 2, 60 per cent, grade 3, 32 per cent.

Age and results. The statement often made that the prognosis in cases of cancer of the breast is worse in women under 40 than in older women is suggested by the analysis of this series. There is, however, a great difference in the figures in the last 3 groups studied. In the 1926-1928 series cure was obtained in 34 per cent of the patients under 40 years of age. In the 1927-1929 series there were only 10 per cent of cures in the group, while in the present series there were 31 per cent cures. That tumors of high degree of malignancy are more common in women under 40, has been shown by one of us (12) and is borne out by our figures. This fact is the reason for the poor prognosis in young women. The point has been discussed previously under the heading, "Pathology and Results."

If the cases are placed in 3 age groups the percentage of cures is as follows: 31 per cent of 29 cases, 18 to 40 years, 48 per cent of 96 cases, 41 to 60 years, 50 per cent of 46 cases, 61 to 80 years. The youngest case in the group was 18 years of age, the oldest 78, 22.5 per cent were under 40 years of age.

Exploratory operation—biopsy. An exploratory operation and biopsy to verify the clin-

ical diagnosis was performed in 34 cases. In 18 of these patients the disease was limited to the breast while in 16 the axillary nodes were later found to contain cancer. Fifty four per cent of these operations resulted in cure. The figures are not significant but suggest that metastases may occur early and before the primary tumor attains a size sufficient to present the characteristic clinical picture of cancer. The method of biopsy employed consisted of an incision directly into the tumor and removal of a small portion for examination. If the tumor was found to be cancer the wound was packed with a sponge wet with 10 per cent formalin and closed. The instruments and gloves were then changed and immediate radical operation performed.

We have felt that the removal of a specimen for diagnosis unless followed immediately by radical operation was a dangerous procedure, and also that aspiration or punch biopsy should not be employed in operable cases on account of the possible danger of dissemination of the disease.

Site of recurrence. Of the 93 patients dying of metastases the site of recurrence is known in 60 instances. There were multiple metastases in 21 cases. The most common site of recurrence was the lungs although bone metastases were nearly as frequent. The sites of recurrence were as follows: local, 10; regional nodes, 11; lung, 25; bone, 24; brain, 8; opposite breast, 6; and liver, 6. The striking point is the relatively few cases of local recurrence, 10 cases in 133 or 7.6 per cent, although sufficient skin was preserved at the time of operation to allow the wound to be closed. We believe this relatively low percentage of local recurrence is due to a careful selection of the cases and to the fact that a large amount of subcutaneous tissue was removed. The figures should be accepted with some reservation for we have such data on only 77 per cent of our cases. It is difficult to say in the 6 cases in which the disease was later found in the other breast whether this represented a metastasis or a new tumor. We have considered them as cases of recurrence. We agree with Scott that recurrence in the operative field is an indication of either a faulty selection of cases for operation or of improper surgical technique.

Twenty patients living 5 years after operation died later of recurrence. In 12 of these evidence of recurrence was present before the arbitrary 5 year period had elapsed but the 8 others were apparently well at that time and showed evidence of metastases later. We have estimated that about 15 per cent of patients living apparently free of disease at the end of 5 years will eventually die of recurrence.

SUMMARY AND CONCLUSIONS

This report is the seventh in a series of end result studies of carcinoma of the breast treated at the Massachusetts General Hospital.

Five to 8 year cures were obtained in 70 per cent of cases in which disease was confined to the breast, in 31 per cent when the axillary nodes were involved and in 45 per cent of the entire group.

The improvement in curability, as compared with previous series may be attributed to standardization of the radical operation and to better selection of cases. Some improvement may be due to shortening of the preoperative duration of the disease as a result of educational programs. We are unable to attribute any of the improvement in results to radiation therapy which was not employed in this series.

Clinical appraisal of axillary lymph node involvement is highly fallible. Nodes may prove to be involved in nearly half of the cases in which no nodes can be felt clinically and in half the cases in which exploration of the primary tumor in the breast is necessary to establish the diagnosis of carcinoma. Nearly two thirds of the entire group proved to have axillary node involvement at the time of operation. There does not appear to be any tendency in recent years for this advanced operable group to diminish in relation to the total group.

The pathological index of malignancy is of great significance in prognosis. In high grade malignancy the tendency is to metastasize earlier and there is a markedly lessened chance of cure by radical operation.

The age of the patient is of prognostic importance only in so far as younger patients tend to present higher grades of malignancy and earlier metastasis to the axilla.

Exploratory incisions, followed by immediate radical operation, do not seem to jeopardize the likelihood of cure

Recurrence in the operative field is rare if proper selection of cases and proper operation are carried out. Wide skin removal at operation, requiring skin grafting for closure is not often necessary.

The authors wish to express their thanks to the staff of the hospital for permission to include certain cases.

BIBLIOGRAPHY

- 1 BRODER, A. C. Squamous cell epithelioma of the lip. *J Am M Ass* 1910, 74: 650.
- 2 DALAND, E. M. Untreated cancer of the breast. *Surg Gynec & Obst* 1927, 44: 262.
- 3 GREENOUGH, R. B. Carcinoma of the breast. *Am J Roentgenol* 1926, 16: 439.
- 4 GREENOUGH, R. B. and SIMMONS, C. C. End results in cancer cases. *Boston M & S J* 1921, 285: 253.
- 5 GREENOUGH, R. B., SIMMONS, C. C. and BARNEY, J. D. The results of operations for cancer of the breast at the Massachusetts General Hospital from 1894 to 1904. *Surg Gynec & Obst*, 1907, 5: 39.
- 6 GREENOUGH, R. B. and TAYLOR, G. W. Cancer of the breast: end results. *Massachusetts General Hospital 1921-1922-1933*. *New England J Med*, 1934, 210: 831.
- 7 MEIGS, J. V. and DRESSER, R. Carcinoma of the cervix treated by the roentgen ray and radium. *Ann Surg* 1937, 106: 4.
- 8 NATHANSON, I. T. and WELCH, C. E. Life expectancy and incidence: carcinoma of the breast. *Am J Cancer*, 1936, 28: 40.
- 9 SCOTT, A. C. Glandular block dissection for metastatic cancer. *J Am M Ass* 1925, 85: 1477-1482.
- 10 SIMMONS, C. C., TAYLOR, G. W. and ADAMS, H. B. Cancer of the breast: end results. *Massachusetts General Hospital, 1927-1928-1929*. *New England J Med* 1936, 215: 521.
- 11 SIMMONS, C. C., TAYLOR, G. W. and WALLACE, R. H. Cancer of the breast: end results. *Massachusetts General Hospital 1924-1925-1926*. *New England J Med* 1934, 210: 836.
- 12 TAYLOR, G. W. Carcinoma of the breast in young women. *New England J Med* 1936, 215: 27.
- 13 TAYLOR, G. W. and DALAND, E. M. The Greenough technique of radical mastectomy. *Surg, Gynec & Obst* 1937, 65: 807.

ONE-STAGE THYROIDECTOMY FOR THYROTOXICOSIS IN THE AGED

H M RICHTER M D F A C S J M MORA M D F A C S and D H WAGNER M D,
Chicago Illinois

IN the early days of the development of thyroid surgery postoperative crisis constituted the commonest cause of death and the greatest dread of the surgeon. Improvement in technique lowered the mortality but on the whole it remained a formidable handicap. The introduction of preliminary ligation and of multiple stage operations seemed to lessen the number of crises and to reduce the mortality. What part these two steps actually played in reducing mortality as compared with the general improvement in technique and the tendency of patients to gravitate toward surgeons and clinics particularly interested in thyroid surgery must be a matter of conjecture. With the introduction of iodine as a means of preparing the thyrotoxic patient for operation mortality and the incidence of postoperative crisis fell rapidly. By this time the proportion of patients subjected to preliminary ligation and multiple stage operations had reached fantastic proportions in some clinics. With the continued use of iodine the need for these various preliminary steps was recognized by many to be lessened but that they are still necessary continues to be believed. Many authoritative writers accept the value of these procedures as established.

Marshall of the Lahey clinic, writes "In our hands the utilization of stage operations has been one of the most valuable means of preventing operative fatalities. In a recent paper Lahey (4) says 'If I were asked to state what is the most important single feature related to the surgery of hyperthyroidism, I believe I would say that it is the pre-operative decision as to how severe the thyroid intoxication is and as to whether the patient will probably require multiple stage procedures. Twenty two per cent of all patients operated upon in the Lahey clinic

for all types of hyperthyroidism underwent multiple stage procedures (5). Seventy five per cent of all patients 60 years of age or over with toxic goiter have been operated upon in stage operations in this same clinic (13). At the Crile clinic the divided operation is reserved for the "bad risk" cases. Between 1930 and 1935 13 per cent of the total number of thyroidectomies were performed in stages and in only 6 per cent were ligations performed (2). At the Mayo clinic the percentage of multiple stage operations decreased from 70 per cent in 1921 to 1 per cent in 1926 (9). Pemberton, in 1929 wrote 'I am convinced that 98 per cent of all patients with exophthalmic goiter can be made safe surgical risks by proper medical management and that the stage operation as a supplemental preparatory measure is indicated in a very small group of patients. During 1927 operations were performed on 1,520 patients with exophthalmic goiter. In only 8 or 0.52 per cent of these were there indications for dividing the resection into two stages. Eleven patients died a mortality of 0.72 per cent. Two died following the first stage lobectomy.

We believe our experience justifies a critical re-opening of the question of multiple procedures in thyroid surgery for thyrotoxicosis. It is not enough for the proponents of these measures to establish that the mortality of thyroidectomy in thyrotoxicosis has fallen year by year. Improved technique and specialization have reduced the mortality in practically all departments of surgery. The attitude so commonly held that after all 2 operations are better than 1 if they make in any way for safety is rather naive. Our contention is that they do not make for safety and 2 hospitalizations must be justified to the average patient by substantial evidence if they are to take the place of 1 operation.

For upward of 25 years the senior author has taught that two basic principles in the operation of thyroidectomy for thyrotoxicosis are first, that the operation should be thoroughly radical, and second that it should be done in one stage. By radical operation is meant the removal of all but a minimal amount of thyroid tissue, irrespective of the size of the thyroid. By one stage is meant just what the word indicates namely, thyroidectomy with out preliminary ligation or multiple steps in the operation. The object to be attained is to leave so little thyroid tissue remaining that a postoperative crisis, presumably caused by leaving sufficient thyroid tissue to permit it to occur, cannot follow. In previous papers (10, 12) it was suggested that it was this residual thyroid tissue, thrown into excessive activity by the very psychic and traumatic stimulation of the operation, that was the cause of reactions after operation. In the light of our present knowledge of the part that liver damage with suppression of function plays in thyrotoxicosis, this is undoubtedly oversimplification of the problem. However the principle remains much the same, since the patient with a highly damaged liver is less able to withstand the effect of the stimulated activity of his residual thyroid. This reaction or crisis is commonly accepted as a major cause of surgical mortality following thyroidectomy for thyrotoxicosis. The practical elimination of crisis as a cause of death should strengthen the basis for the use of a one stage radical operation. If the principle is correct, it should show to the best advantage in the more severe types of cases, such as young children, patients intensely or fulminantly toxic and the old and infirm with their associated cardiac and other visceral complications. Our results in children and in the aged have been the subject of previous communications by one of the junior authors (J M, 3). In 1931, Mora and Greene reported 200 consecutive single stage thyroidectomies for thyrotoxicosis in patients over 50 years of age. The present paper presents a further report of thyroidectomy in the aged, consisting of 270 consecutive patients over 50 years of age, operated upon since the earlier series was completed. In all cases the technique previously described (11) was carried

out by the senior author. These 270 cases occurred in a consecutive series of 600 patients. It must be emphasized that these operations were for thyrotoxicosis and included cases of primary hyperplastic thyroid and so called toxic adenoma. Non toxic goiters, nodular or otherwise, are not included.

The degree of illness in these patients is indicated by the fact that 37 of the 270 were decompensated just prior to or at the time of operation. Of these 37 there were 15 who were badly decompensated, 5 of them with marked cyanosis, edema of the legs, abdominal wall, and genitalia, 5 with ascites, and 2 with bilateral hydrothorax in addition. One patient had an aneurism of the aorta associated with a large heart and auricular fibrillation. Four, in addition to thyrotoxicosis and cardiac damage had an associated severe diabetes and 2 of these were further complicated by hypertension with systolic blood pressures above 200. One was further complicated by acromegaly and profuse sialorrhea. Lighten of the 270 patients had diabetes of varying severity and 1 was further complicated by a depressive psychosis at the time of operation. One patient was in crisis and 1 exhibited marked mental aberration just prior to preparation for operation, 2 had associated cerebrospinal syphilis, 1 had epilepsy and had had her last attack 6 weeks prior to operation. 1 patient had pernicious anemia.

For any publication such as this, which is essentially a challenge of the idea so widely held, that multiple stage operations in the seriously toxic patient make for a lowering of the mortality, it is necessary that the objective data be such that their value can be estimated and compared easily. Of these we regard the basal metabolic rate as the most valuable for the purpose, not that it takes the place of adequate clinical study, but that the latter is much more subject to the bias of the observer. No data are more fallible, however, than those of the basal metabolic rate when obtained from uncontrolled sources. The patients included in this paper were studied under controlled conditions. Some had first come under observation after receiving iodine preparation. If the patient's condition permitted, the iodine was stopped until adequate

study was possible. A few cases are included in which the patient's condition was such as to make the diagnosis obvious and the interruption of iodine not justifiable. All patients were subjected to the usual clinical study.

Accurate pre-operative basal metabolic rates were obtained in 268 of the 270 patients. The total number of pre-operative basal metabolic rates taken was 861 making an average of 3.2 rates per patient. Two hundred five of the 270 patients had basal metabolic rates above plus 30 and 144 of these had basal metabolic rates of above plus 40. Forty five of the 63 remaining had basal metabolic rates varying between plus 20 and plus 30. Eighteen had basal metabolic rates below plus 20. Fourteen of these 18 had had previous iodine preparation. Four had clinical manifestations of toxicity and a characteristic response to iodine.

The age of the patients ranged up to 77 years. They included all varieties and all stages of the various complications that one would expect in the aged. Operation was not refused regardless of what complication the patients presented provided they showed evidence of thyrotoxicosis as well. There were 176 patients between the ages of 50 and 59, 83 between the ages of 60 and 69 and 11 were past 70 years of age, the oldest being 77 years of age.

Weight loss occurred in 147 of the 270 patients. The average weight loss was 25.5 pounds. Loss in weight is necessarily based on the patient's estimate of his previous normal weight and is obviously an approximation only.

Patient number	Weight loss in pounds
60	20 or less
43	20 to 30
24	30 to 40
12	40 to 50
8	50 to 60

The table shows that 44 of the patients lost more than 30 pounds prior to the operation. The maximum weight loss was 60 pounds within a period of 4 months.

In the old age group hypertension definitely increases the hazard of thyroidectomy not only because of the possibility of thrombosis or hemorrhage but because hypertension is

often only one of the complications. It may well be associated with decreased kidney function and often these patients have accompanying myocardial damage. In our study 65 or 24 per cent, showed a systolic blood pressure above 170 millimeters of mercury and a diastolic blood pressure above 90 millimeters of mercury, 38, or 14 per cent, showed a systolic blood pressure above 200 millimeters of mercury and a diastolic blood pressure above 100 millimeters of mercury.

Perhaps the most hazardous and most difficult patients to operate upon successfully are those in whom old age is complicated by thyrotoxicosis and cardiac failure. The degree of cardiac failure, the presence of some other associated disease process such as diabetes or hypertension makes each patient in this group a different and difficult problem.

Clute and Swinton state that 60 of their 143 patients of 60 years or over showed either auricular fibrillation or cardiac failure. Twenty of these 60 showed cardiac failure. Magee and Smith of the Mayo clinic show an incidence of 237 cases of auricular fibrillation out of 304 patients past 50 years of age. They state that among 210 cases of auricular fibrillation associated with hyperthyroidism cardiac enlargement occurred in 79. In the same group of cases of auricular fibrillation cardiac decompensation was present in 62.

In our series 120 or 44 per cent, showed some signs of cardiac pathology such as enlargement, auricular fibrillation or cardiac failure. Auricular fibrillation was present in 48 of the patients. In 27 of these, fibrillation stopped following thyroidectomy. Sixteen continued to fibrillate, being unaffected by thyroidectomy. Fourteen of the 16 were followed from 1 to 8 years, 1 was followed for 10 months after operation, and 1 was followed for 4 months. We have been unable to follow the 5 remaining patients.

Cardiac failure was present in 37 or 13.7 per cent, of the 270 patients. It was of varying intensity but in some instances, as previously indicated, the operative risk was hazardous. Twenty nine who were followed from 6 months to 4 years showed definite cardiac improvement after thyroidectomy. Of the 8 remaining 3 who were seen 1 to 2 months

after operation were definitely improved, 1 fourth patient never returned for study following operation, the fifth patient was improving but died suddenly 2 months after operation, 3 patients were unimproved. These were followed for 2 years, 5 months, and 1 month, respectively.

In the postoperative examination of these 270 patients, 224 were subjected to repeated basal metabolic rate studies. There were 727 basal rates taken, making an average of 3.24 rates per patient. Of those followed 213 had a persistent metabolic rate below plus 15. Eleven had a basal rate above plus 15. Four of these 11 patients had but one postoperative basal rate determination and that within 4 weeks of the time of operation. Three of these 4 could not return for further study. The other one, seen 4 years after operation, was clinically very well, but no basal rate could be obtained. The fifth patient developed a recurrence and was successfully reoperated upon. The sixth patient had a recurrence of toxic symptoms 1 year after operation. Under iodine therapy the basal metabolic rate returned to normal and remained at minus 9, plus 1, and minus 14, the last reading being taken 21 months after operation. The seventh patient had a mild residual thyrotoxicosis with basal metabolic rates of plus 14, plus 26, and plus 21, 1 and 2 years after operation. The 4 remaining patients had unaccountable raised basal rates entirely at variance with the clinical picture. All of them showed an obvious absence of thyroid toxicity during the postoperative follow up periods of 4, 10, 14, and 18 months, respectively.

Of the 46 patients on whom we did not secure postoperative basal rates, 30 were reported as relieved of their thyrotoxicosis, based on clinical studies by their own physicians. They were followed for 3 months to 8 years. We have been unable to follow the remaining 16 patients because of death, residence in other cities, and failure to co-operate with us. In line with our attitude toward a report of this type, the basal rates obtained by other physicians or at unknown laboratories are not included in this report. Only 2 patients were reported to have had repeated elevated basal rates.

There were 43 patients with clinical hypothyroidism of whom 10 required thyroid substance for 3 years or more. The remainder were easily controlled by small doses of thyroid substance. This group includes 1 patient upon whom a total thyroidectomy was performed for thyrotoxicosis and heart disease.

Attention is called to the fact that this is a rather high percentage of hypothyroidism, but the operation is aimed at keeping the basal metabolic rate at a low level over a fairly substantial period after operation.

Four patients developed reactions after operations. One patient in whom before operation a diagnosis of thyrotoxicosis, diabetes, aeromegaly, and damaged heart, had been made, had with these a marked increase in salivation. This sialorrhea was severe enough before operation to require the use of a large box of tissues daily. She developed an enormous edema of the lungs on the first day after the operation and her pulse rate rose to 160. She became comatose for a short while but improved under an oxygen tent and in 48 hours was over the reaction. It was necessary to place this patient in prone position from time to time to help empty the bronchial tree of excessive secretion. This reaction was unaccompanied by toxic symptoms. The second patient's temperature rose to 104 degrees on the second day and receded gradually until by the fourth day the patient was very much improved. The third patient developed a rising temperature and pulmonary edema 36 hours after operation. The temperature rose to 103.4 degrees with associated restlessness and tachycardia. At the end of 48 hours she was in excellent condition. A fourth patient exhibited a rise in temperature to 104 degrees on the day following operation, which was accompanied by auricular fibrillation. Thus only 3 of the 270 patients subjected to one stage thyroidectomy presented thyroid reactions after operation.

There were no deaths in the entire series of 270 consecutive patients reported in this paper. These patients represent the high risk group in thyroid surgery. We feel we must insist that these results justify the principle of the one stage radical operation, and particu-

larly that they raise a serious question as to the propriety of multiple stage operations in any case

SUMMARY

Two hundred seventy consecutive thyrotoxic patients over 50 years of age were subjected to one stage radical thyroidectomy without a death. During the period in which these patients were operated upon, 900 thyroidectomies for thyrotoxicosis in every age group were performed with 3 deaths, or a mortality of 0.33 per cent. These data are presented as evidence in favor of the routine use of a radical one stage operation for thyrotoxicosis.

BIBLIOGRAPHY

- 1 CLUTE H M and SWINTON N W Hyperthyroidism in the aged. *Ann Surg* 1935 101 1181-1189
- 2 DINGMORE R S and CAILE GEORGE Jr Thyroid problems and end results of operations. *Surg Clin. America* 1935 15 839-844

- 3 GREENE E I and MORA J M Thyroidectomy for thyrotoxicosis in the young. report of 26 cases between the ages of 8 and 16 years. *Surg Gynec & Obst.* 1931 53 375-377
- 4 LANEY FRANK H Reduction of mortality in hyperthyroidism. *New England J Med* 1935 213 475-479
- 5 Idem Stage operations in hyperthyroidism. *Surg Clin America* 1935 15 1611-1624
- 6 MACFEE H R and SMITH HARRY L Auricular fibrillation in hyperthyroidism. The influence of age. *Am J Med Sc* 1935 180 683-690
- 7 MARSHALL SAMUEL F Hemithyroidectomy in stages in the treatment of hyperthyroidism. *Surg Gynec & Obst* 1937 64 1055-1063
- 8 MORA J M and GREENE E I Thyroidectomy for thyrotoxicosis in older people. *Am J Med Sc* 1931 181 74-80
- 9 PEMBERTON JOHN DE J Exophthalmic goitre. Indications for stage operations. *Arch. Surg* 1929 18 735-744
- 10 RICHTER H M Thyroidectomy in toxic goitre. *J Am M Ass.* 1919 73 1264-1265
- 11 Idem Thyroidectomy. *Surg Gynec. & Obst* 1929 49 6-5
- 12 Idem Thyroidectomy for thyrotoxicosis. *Surg Gynec & Obst.* 1932 54 551-554
- 13 SWINTON N W Hyperthyroidism in elderly patients. *Surg Clin America* 1936 16 1547-1555

ANOMALIES OF RENAL ROTATION

HENRY M WEYRAUCH, Jr. A.B., M.D. F.A.C.S., San Francisco California

THE faulty rotation of ectopic and fused kidneys is well recognized. This paper deals exclusively with the etiology and clinical aspects of anomalous rotation in kidneys which have reached the lumbar level during embryonic development and in which the factor of renal fusion plays no part in accounting for the anomaly. Nine teen cases are included in the present report.

Anomalous rotation is a congenital abnormality which is manifested by an atypical location of the hilum renale. It should not be confused with renal torsion which is an acquired displacement of the entire kidney.

Although an infinite number of intermediate malpositions of the renal pelvis may characterize the derangements of rotation, for the purposes of a clinical classification 4 main types are listed here: (1) ventral or non rotation (rarely excessive rotation), (2) ventromedial or incomplete rotation, (3) lateral rotation (reverse or excessive rotation), and (4) dorsal rotation (excessive or reverse rotation).

EMBRYOLOGY

The migration of the kidney has been spoken of commonly as a process of ascent and rotation. Hinman has observed, however, that the supposed ascent of the kidney is more apparent than real. The change in position actually takes place because of a more rapid growth of the body, especially the trunk, than of the kidney, this organ occupying relatively the same position in the adult as it does in early embryonic life.

Likewise, as brought out by Prisman, it is more rational to view the change in position of the renal pelvis as a manifestation of differential regional growth than as an actual rotation of the kidney. A gradual intrarenal displacement of the pelvis produces the ap-

From the Urological Division, Duke University School of Medicine and Duke Hospital, Durham, North Carolina, and the Department of Surgery, Division of Urology, University of California Medical School and Hospital.

Supported in part by the Christine Breton Fund for Medical Research.

pearance of rotation which does not actually occur. Table I summarizes those details of early human embryonic development which will be considered in interpreting the errors of renal rotation.

It is during the time that the first 5 orders of tubules coalesce to form the renal pelvis that this structure undergoes its medial excursion and the kidney itself makes a pseudo ascent out of the pelvis of the embryo. In embryos of 12.5 millimeters (greatest length), the primitive renal pelvis and its first collecting tubules still lie dorsal to the ureter (Fig. 1 A). Shortly thereafter the pelvis commences its ventromedial excursion (Fig. 1 B) and, in embryos of 19.5 millimeters (greatest length), it has assumed the medial position (Fig. 1 C).

The successive orders of collecting tubules are formed by a process of dichotomous branching. Felix has noted that tubules of the second and third order onward usually send out 2 branches ventrally to one in the dorsal direction. Following each division of the ureteral tree, there is a rapid multiplication of cells as the metanephrogenic tissue grows to encase completely the budding tubal stem. Each new ureteral tree and its metanephrogenic cap constitute a malpighian pyramid. These pyramids are marked by grooves which produce a lobulation of the renal surface. The lobulations persist until birth and disappear in the early years, although under some circumstances they persist throughout life.

As described by Felix, the permanent renal circulation is established through the mesonephric arteries at the time the excursion of the renal pelvis is being completed. These arteries arise as transverse branches from the aorta and terminate in the rete arteriosum urogenitale which is a network that lies ventral to the metanephros in the angle formed by the reproductive gland, the mesonephros and the metanephros (Fig. 2).

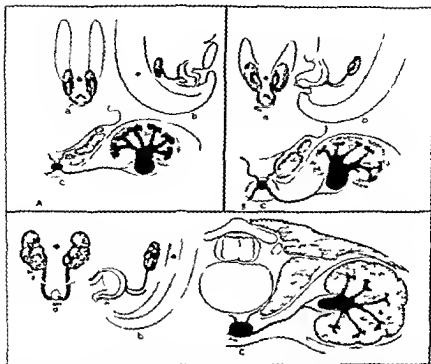


FIG. 1. Diagrammatic representation of the excursion of the renal pelvis, the so called rotation of the kidney. *a* Ventral view. *b* Sagittal section through the mid line of the embryo. *c* Transverse section at the level of the second lumbar vertebra indicated by cross in *a* and *b*. The diagrams show how the kidney retains much the same level in the embryo (the second lumbar vertebra) during this period.

A. Human embryo 9.5 millimeters in length (about 6 weeks old). The renal pelvis and first collecting tubules lie dorsal to the ureter. There is very little metanephrogenic tissue at this stage.

B. Human embryo 16 millimeters in length (about 7 weeks old). The renal pelvis is midway in its excursion to a medial position. Note the lateral dominance of the ureteral trees with the surrounding proliferation of the metanephrogenic tissue producing the medial shift best seen in *c*.

C. Human embryo 19.5 millimeters in length (about 9 weeks old). The renal pelvis faces the midline at the completion of its excursion. The lines along which the metanephrogenic tissue surround each pyramid begin to form lobulations. Note how the anterior lip of renal parenchyma has curved ventrally around the pelvis.

In embryos of 18 millimeters (greatest length) the network comes into connection with the vessels which actually enter the renal sinus. Normally the vascular pedicle enters the hilum renale ventral to the pelvis at approximately the same time the medial shift is completed. The network makes it possible for any of the mesonephric arteries to become the metanephric artery and also explains the variability in the origin of the renal artery, the frequent dissimilarity on the right and left sides and their frequent multiplicity. A persistence of more than one of the numerous venous communications similarly accounts for anomalies of the renal vein.

COMPARATIVE ANATOMY

Some animal phyla retain as permanent excretory organs kidneys which represent early stages in human embryonic development. It will be shown that the primitive metanephric form found in reptiles and birds closely resembles one of the anomalies of rotation. As seen in the chicken, such a kidney extends far caudad, is lobulated, and presents an embryonic type of pelvis which is located on the ventral aspect (Figs. 3 and 4).

PATHOLOGY

The derangements of renal rotation possess many characteristics which are pathogno-

Fig 2 Diagram showing the manner of renal vascularization. Vessels springing from the aorta form the rete arteriosum urogenitale which lies ventral to the metanephros in the angle formed by the reproductive gland the mesonephros and the metanephros (From Felix)

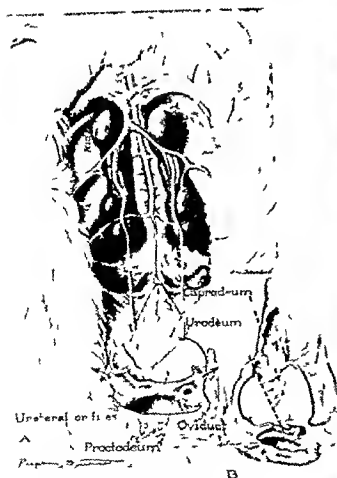
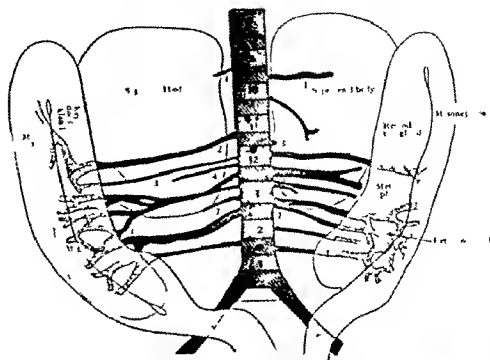


Fig 3 Primitive type of metanephric kidney as seen in the chicken. The kidneys extend far caudad lobulations persist throughout life and the pelvis retains a ventral insertion. The ureters empty into a cloaca shown in B



Fig 4 Pyelogram of chicken. Note the long narrow primitive type of embryonic pelvis which gives off abbreviated calyces at regular intervals. Inset Lateral pyelogram of the pelvis and ureter in a ventral position

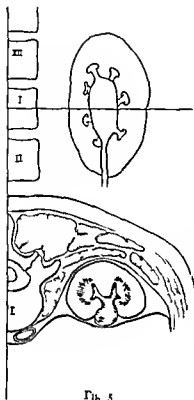


Fig. 5

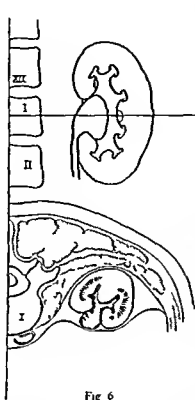


Fig. 6



Fig. 7

Fig. 5 Ventral rotation. Pelvis lies ventral to calyces as seen in early embryonic life. Compare with Figure 1A.

faces the median line of the body. Compare with Fig. 1B.

Fig. 7 Lateral rotation. The pelvis lies lateral to the medially directed calyces.

monic of an arrested or distorted embryonic growth. Most distinctive is the malposition of the hilum renale. In *ventral rotation* the pelvis is situated in its original embryonic position lying directly ventral to calyces which point dorsally (Fig. 5). *Ventromedial rotation* is a condition in which the pelvis partially faces the midline of the body, lying medial to the dorsolaterally directed calyces (Fig. 6). *Lateral rotation* is manifested by a lateral position of the pelvis (Fig. 7) and *dorsal rotation* by a dorsal insertion (Fig. 8).

A widely exposed renal pelvis is one of the common findings in anomalous rotation (Figs. 9 and 11). In extreme instances there is a complete absence of the hilum renale the original calyces being separated on the surface of the kidney (Fig. 13).

Although the pelvis may be normal in shape, a distinctive embryonic type is sometimes encountered. Such a type exhibits lengthening and narrowing of the pelvis ab-

breviated calyces often clubbed being given off at more or less regular intervals (Fig. 15). Again the calyces as well as the pelvis may be elongated (Fig. 19) or an elongated cephalic calyx may be a distinguishing feature (Figs. 16 and 17). In some cases the pelvis is ensheathed in broad layers of adherent fibrous tissue which fix the pelvis and contiguous ureter to the adjacent surface of the kidney and peritoneum (Figs. 9, 11, and 13). There may be a lateral displacement of the upper third of the ureter which is most extreme in lateral rotation (Figs. 10, 14, 15, 17, and 19).

Another characteristic is a discoidal shape of the kidney. As compared to the normal such a member is either oval or roughly triangular in shape and exhibits an anteroposterior flattening (Figs. 9, 11, 17, and 20). The persistence of fetal lobulations may also complicate the errors of rotation (Figs. 11 and 18).

The blood supply is subject to wide variations. Sometimes an artery and vein discharge

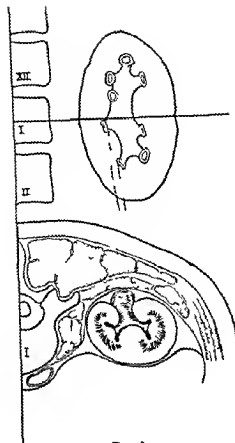


Fig 8

Fig 8 Dorsal rotation. The pelvis lies on the dorsal aspect of the kidney behind ventrally directed calyces.

Fig 9 Bilateral ventral or non rotation (Case 8) as seen at operation. Note the discoid shape of the kidneys, the widely exposed dilated pelvis and the aberrant blood vessels piercing sheets of fibrous tissue which fix the upper portions of the ureters and the pelvis to the

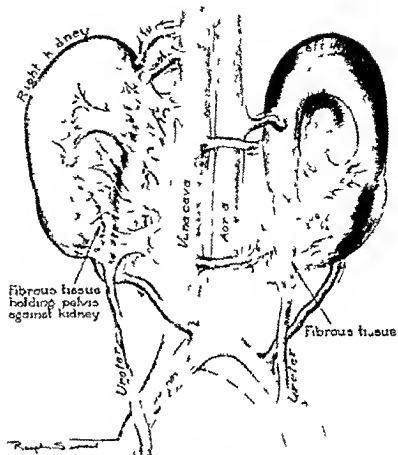


Fig 9

parenchyma of the kidney and the peritoneum. The artery and vein entering the superior aspect of the right kidney are typical polar vessels. (See Figure 10 demonstrating bilateral ventral rotation.)

branches through the hilum renale in the normal manner (left kidney, Fig 11). In other instances the organ is completely supplied by aberrant vessels which are distributed to the parenchyma at points distant from the hilum (Fig 9). The most frequent termination is at one pole or the other, the vessels being known as polar vessels (Figs 11 and 20). Finally, aberrant vessels may be present in conjunction with a normal artery and vein (Figs 11, 18, and 20). Before entering the kidney the vessels are often found to penetrate fibrous bands such as have been described (Figs 9 and 11). In coursing over an expanse of parenchyma, they commonly lie in a channel of variable depth which has been hollowed out along the path of the vessel (Fig 13). The entrance of the vascular pedicle dorsal to the renal pelvis may be the sole feature which identifies ventromedial

rotation from the normal (right kidney, Fig 11). From a physiological standpoint the anomalies of rotation demonstrate no impairment of function unless complicated by such factors as obstruction or infection.

ETIOLOGY

As a starting point in deciphering congenital anomalies Bremer suggested that, "An embryological explanation of any anomaly should show that from some pre-existing embryological condition both the normal and abnormal results may be derived, the agents which cause the anomaly should be simple in themselves, as pressure or the blocking of a vessel, or the relative overgrowth or arrest of development of certain parts, though the ultimate cause of these agents will usually remain



A



B



C

Fig 10. Pyelograms demonstrating bilateral ventral rotation (Case 8). Note the bilateral hydronephrosis. A Recumbent pyelogram before operation. B upright pyelogram before operation revealing bilateral nephro-

ptosis. C upright pyelogram following bilateral nephropexy and ureterolysis. The anomalous rotation has been maintained. It will be noted also that the nephropo- ptosis is no longer present.

a mystery. Not infrequently other vertebrates may develop normally in ways which for man would be abnormal; the citation of such instances strengthens the explanation of any human anomaly.

The investigations of Spemann further illuminated the approach to these problems by the recognition of organizing influences and chemohormonal as well as purely mechanical explanations for the processes of growth, both normal and abnormal.

Assuming a normal ventral insertion of the primitive renal pelvis, one may hypothesize on the 4 following errors of pelvic excursion in accounting for the derangements of renal rotation.

1 *Von rotation*. A failure of any attempt toward an excursion in either a medial or lateral direction logically explains the condition found in ventral or non rotation. The pelvis maintains its original embryonic position (Fig 1 A) similar to the normal arrangement in some species of reptiles and birds (Fig 3).

2 *Incomplete rotation*. An interruption of the pelvic excursion at approximately the stage of the seventh embryonic week, at some point midway in the normal medial shift (Fig 1 B) gives rise to the ventromedial deformity.

3 *Excessive rotation*. A prolongation of the excursion of the pelvis beyond its normal medial location may result in an anomaly of dorsal rotation, lateral rotation, or in extreme instances in one of ventral rotation; the pelvis

making a circuit of 190 degrees, 270 degrees or 360 degrees respectively, from its original position.

4 *Reverse rotation*. A shift in the direction opposite to the normal could account for the position of the pelvis in lateral rotation or dorsal rotation; the circuit being one of 90 degrees or 180 degrees respectively.

Clinically it is impossible to differentiate types of reverse rotation from those of excessive rotation. At operation or necropsy, however, a clue to the direction of the pelvic excursion may sometimes be obtained by ascertaining the course of the vascular pedicle. As has been described, the kidney forms its blood supply from the mesonephric vessels which pass ventral to it (Fig 2). When the pelvis makes a prolonged anomalous excursion it is likely that permanent vascularization will be established at some time before the pelvis comes to rest.¹ In such an event it has been observed that the pelvis draws along any closely associated vessels in the direction of its circuit. Having an original insertion in the ventral or ventromedial aspect of the kidney, therefore, the main renal vessels will pass ventral to the kidney in reverse rotation and dorsal to it in excessive rotation. Unfortunately, the presence of a completely aberrant blood supply may prevent the application of this principle.

¹Spemann noted that if the pelvis will, the process of differentiation is very lightly differentiated. The pelvis will protect itself from the growth of blood vessels. This is why it would be a possibility of the growth of the pelvis.

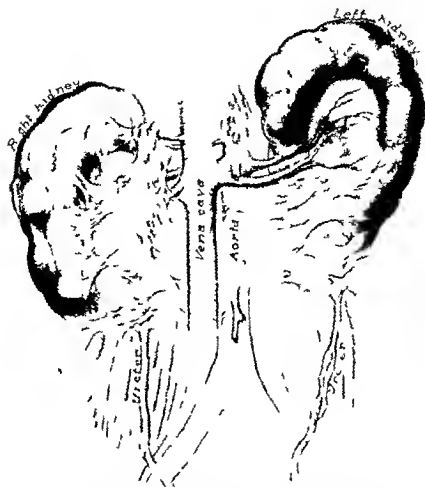


Fig. 12 Left ventral rotation and right ventromedial rotation (Case 11) as seen at operation. Note the widely exposed hydronephrotic pelvis, the lobulations of the renal parenchyma and the fibrous bands fixing the pelvis and upper portions of the ureters to the parenchyma of the kidney and peritoneum. On the right polar vessels enter the superior pole. The main vascular pedicle passes dorsal to the pelvis establishing the diagnosis of ventromedial rotation. Both groups of vessels pierce bands of fibrous tissue in supplying the kidney. (See Figure 12.)

The ventral course of the blood vessels in Case 19 (Fig. 13) gives evidence of a reverse excursion of the pelvis in attaining the position of lateral rotation. On the other hand, in Case 16 (Fig. 18) the dorsal course of the renal artery and vein indicates an excessive excursion of the pelvis. Labey and Paris described a kidney in the position of ventral rotation in which the main vascular pedicle passed dorsal to the kidney before it entered the hilum lateral to the pelvis (Fig. 20). This pathological relationship plainly indicates that the pelvis made a complete circle of 360 degrees in the normal direction before coming to rest in its original ventral position. The mechanism is, therefore, one of excessive rotation.

Such instances of a total disregard for neighboring vessels as either anchoring agents or hindrances to the excursion of the pelvis indicate that the factors influencing the pelvic shift are independent of those which control vascularization. It is improbable, therefore, that an anomalous vascularization or one that is premature or delayed—either normal or anomalous—could play any role in accounting for the errors of rotation.

This view gains additional support from observations on the manner of vascularization in the normal embryo. When the testis is formed in the lumbar region, for example, it is not fixed there by its vascular communications with the aorta and inferior vena cava or left renal vein. Quite unimpeded, as the



Fig. 12. Pyelogram demonstrating left ventral rotation and right ventromedial rotation (Case 11). Note the bilateral hydronephrosis. Inset shows *a* the recumbent position *b* the upright position. (From Hinman.)

trunk lengthens the organ makes its journey to the scrotum carrying along its blood supply as it goes. For these reasons one questions the hypothesis that is forwarded in many urological texts that the abnormal position of ectopic kidneys is determined by anomalous vascular attachments. It seems to me that vascularization is secondary to other more powerful forces which regulate the form position and relationship of organs.

The conception of rotation as an intrarenal excursion of the pelvis invalidates those mechanical theories which attempt to explain normal and faulty rotation on the basis of extrarenal forces. It becomes necessary therefore to scrutinize such intrarenal forces as might produce rotation. Let us first consider the ureteral tree as the prime motivating agent in the formation of the kidney. Speermann showed that certain embryonic structures, which he termed organizers, possess the remarkable power of causing other embryonic tissues to differentiate or organize in a

particular manner. What evidence points to the ureteral tree as the organizer of the renal blastema in metanephric development?

Boyden performed a series of experiments which clearly proved that the nephrogenic component of the kidney does not grow in the absence of the ureteral component. By destroying the distal ends of the wolffian ducts in chick embryos, he successfully prevented the formation of a ureteral bud in many instances. Although the renal blastema invariably appeared subsequently even in the ab-



Fig. 13. Right lateral rotation (Case 19) as seen at operation. Note the dilated pelvis and original calyces exposed on the renal surface. The vascular pedicle lies in a groove formed in the ventral aspect of the parenchyma giving off tributaries along its course. This ventral location of the pedicle establishes the anomaly as one of reverse rotation. A few fibrous bands fix the upper portion of the ureter to the parenchyma at the lower pole. (See Figure 24.)

sence of the ureteral elements, there was no differentiation into secretory tubules, and a lessening density predicted its eventual disappearance. In studying a human embryo 10 millimeters in length, Boyden found tubules being formed in a normal right blastema but no evidence of such activity in the left blastema which lacked a ureter.

Nicholson made the pertinent observation that the ureter precedes and, therefore, controls the blastema in differentiation. He further stated that there is on record no case of ureteral agenesis in which there was a mass that might represent renal blastema. If the renal blastema were self differentiating in the absence of a ureteral bud, one would expect to find some mass, most likely cystic, at or near the level of the bifurcation of the aorta.



Fig. 14

Fig. 14 Pyelogram showing right lateral rotation and mild hydronephrosis (Case 10). Note the lateral displacement of the upper third of the ureter.

Fig. 15 a Right ventral rotation (Case 7) confirmed by right oblique lateral pyelogram (inset) and at operation. Note the elongated embryonic type of pelvis giving off clubbed abbreviated calyces at fairly regular intervals. b Left ventral rotation (Case 3) proved by left



a Fig. 15 b



Fig. 16

oblique lateral pyelogram (inset). The calyces in this instance are not clubbed and the pelvis more closely approximates the normal conformation.

Fig. 16 Pyelogram demonstrating left ventral rotation (Case 5) as established by a left oblique lateral view (inset) which shows the pelvis directly ventral to the calyces. Note the embryonic type of pelvis with the distinguishing elongated cephalic calyx.



Fig. 17 Bilateral ventral rotation (Case 9). Pyelograms show the pelvis lying in the midportion of disc shaped renal outline. Lateral view established the ventral location of the pelvis. Note the lateral displacement of the upper portion of both ureters and the elongated cephalic calyx on the left.

Further weight is lent to this conception by the work of Brown who discovered an inherited factor of retardation in renal development following radiation of a strain of mice. In order to form a functioning kidney she found it absolutely necessary that the ureter penetrate the blastemic mass. Brown explained retarded ureteral growth on the basis of a deficient or unbalanced germplasm. In making tissue cultures Drew observed that although pure renal epithelium grew as undifferentiated sheets the addition of connective tissue induced differentiation and the formation of rudimentary tubules.

Previous note has been made of the manner in which the nephrogenic tissue organizes around each branching of the tubal stem during normal metanephric development. All of these facts speak strongly for an activating or organizing power inherent in the ureter.

Primer emphasized that at the time of rotation the ureter branches very rapidly. After providing this valuable clue toward

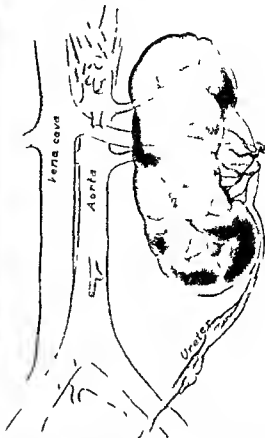


Fig. 18 Left lateral rotation (Case 16) as seen at operation. The main vascular pedicle passes dorsal to the kidney in order to enter the hilum thereby indicating an etiology of excessive rotation. Note the lobulations and the aberrant artery to the upper pole. (Courtesy of Dr. J. T. Lutten) (See Figure 19)

solving the intricacies of rotation however he reverted to a mechanistic explanation. He claimed that the divisions of the primary renal pelvis grow more easily in the lateral and especially in the ventral direction because the growth in the dorsal and medial directions is limited by dorsal body wall. This belief seems untenable when one studies cross sections of embryos during this period. Figure 21 (taken from Felix), representing a human embryo 19.4 millimeters in length shows that well through the stage of pelvic excursion the metanephros is surrounded by the loose mesenchyme of the retroperitoneum on its dorsal, medial, and lateral aspects.

It seems more logical to attack the problem by assuming that renal ascent and rotation



Fig. 19 Pyelogram showing left lateral rotation (Case 16). Note the elongation of the renal pelvis which suggests a renal tumor. The ureter is displaced laterally in its upper third (Courtesy of Dr. J. F. Luten.)

represent characteristics of a higher type of kidney. The mammalian kidney is advanced over the primitive metanephros seen in some vertebrates, such as the bird (an offshoot of man's family tree), by a more complicated ureteral development, manifested in part by a more fully developed pelvis which undergoes a medial excursion.

Granting that the pelvic excursion is a manifestation of advanced renal development, how is it brought about? Mention has been made of the manner in which tubules of the second and third order onward send out 2 branches ventrally to one in the dorsal direction (Fig. 1B, c). When one considers how the elaborate ingrowth of metanephrogenic caps follows each successive division, this factor of excessive ventral branching contributes the first step toward explaining the change in the position of the pelvis.

A medial instead of a lateral movement of the pelvis is best explained by a process of

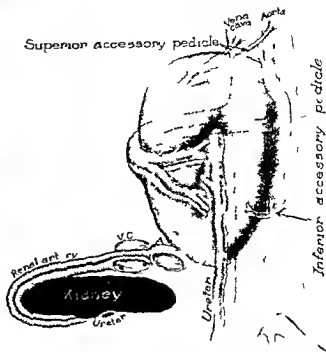


Fig. 20 Right ventral rotation attended by an excursion of the pelvis of 360 degrees in the normal direction as indicated by the dorsal course of the main vascular pedicle. The mechanism is one of excessive rotation. Note the triangular flattened discoid shaped kidney. Two groups of polar vessels are seen (After Lacey and Pans.)

dichotomy and lateral dominance as applied to the ureteral tree. As a predominantly horizontal dichotomous branching takes place, lateral dominance influences a lateroventral growth of successive orders of tubules with an inevitable medial shift of the pelvis. Figure 22 (taken from Felix), a model of the right ureteral tree of an embryo 19.4 millimeters long shows how the early orders of tubules curve medially around the pelvis (also see Fig. 1C, c).

A vicarious or reverse excursion of the pelvis would result from a transference of the lateral to a medial dominance. An analogous transference is common in other organs of the body. Spemann and Falkenberg, for example, traced various stages of a transposition of the thoracic and abdominal viscera to a transference of the normal dominance of the right half of the blastoderm to an abnormal dominance of the left half. Either partial or complete transference may take place.

The infinite possibilities afforded by various degrees of transference of dominance, or by a deficiency or excess of those factors producing

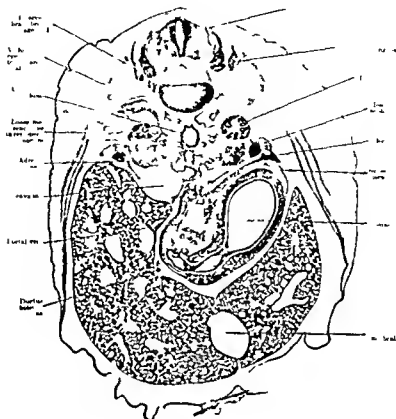


FIG. 21. Cross-section of a human embryo 10.4 millimeters in length showing the metanephros lying in the loose mesenchyme of the retroperitoneum. Note the relatively enormous size of the liver at this stage. (From Teich.)

dominance could account for every possible type of anomalous renal rotation. The ultimate causes of these changes are still undefinable although from the experimental data so far available they have been variously expressed as alterations in germplasm, in hormonal activity, or in metabolic activity, or have been attributed to variations in the chemical structure or the temperature of the tissues at organization centers.

Apart from a faulty excursion of the pelvis, an entirely different etiology must be considered as the possible cause of dorsal and lateral rotation. A late insertion of the ureter on an atypical aspect of the renal blastema is well within the realm of possibility. At the time of the appearance of the ureteral bud the mesonephros and liver are undergoing rapid

proliferation (Table I). The rapid expansion of these comparatively large intra abdominal organs results in a considerable widening of the abdominal region in the embryo and a lateral displacement of the wolffian ducts during a critical stage in renal development. Should the ureteral bud make a late appearance it would arise from a more lateral position than usual. In the event of a delayed union with the renal blastema both components would be older and a permanent anomalous position of the renal pelvis might result. This circumstance might also arise from an abnormally high budding of the ureter from the wolffian duct.

The anomalies of renal rotation are common to both sexes: 13 males and 6 females comprised this series. In age the patients ranged

TABLE I—STAGES IN EARLY HUMAN EMBRYONIC DEVELOPMENT OF THE PRONEPHROS, MESONEPHROS AND METANEPHROS

Embryo		Pronephros	Mesonephros	Metanephros	Renal vessels	Liver
mm	weeks					
17		Appears				
25		Growth	Appears			Appears
45 to 53		Degenerates	Rapid growth	Appearance of ureteric bud and renal blastema which lies medially		Extensive proliferation of cells in lateral and ventral wall
7	5			Metanephrogenic cap (blastema) grows around ureteric bud		Liver continues to grow rapidly
85 to 95	5			Ureter grows cranially into retroperitoneum		
95 to 13	5 to 6			Ureteric bud halted by outgrowing collecting tubules of 1st order establishing definitive level of renal pelvis in foetus (and lumbar vertebra)	Mesonephric arteries take origin as transverse branches of aorta. Formation of terminal network—rete arteriosum urogenitale	
125 to 195	6 to 9		First period of degeneration	Medial rotation of pelvis at 5 mm. pelvis and 1st order of collecting tubules dorsal to ureter at 10.5 mm. ureteric tree lateral to pelvis. Formation of collecting tubules up to 5th and 6th orders	18 mm. network comes into connection with vessel entering renal sinus. Vessels of metanephros thus connected by mesonephric arteries to aorta	
21 to 30	10		First period of degeneration completed at 21 mm	Some observers place completion of rotation at 30 mm (Pruzan)	21 mm. mesonephric artery destined for metanephric duct pinched from its fellow by a greater diameter	
70			Second period of degeneration	Actual capsule of kidney first distinctly seen at 70 mm. Formation of collecting tubules of 9th, 10th and 11th orders		

from 16 months to 53 years, the average age being 29 years at the time the condition was recognized. The incidence of the various anomalies is listed in Table II. No case exhibited dorsal rotation although Campbell has seen 2, and Papin a number of cases of this type. There is apparently no predilection to

either the right or the left side, the right being affected 10 times and the left 13 times.

SYMPTOMS

Uncomplicated derangements of renal rotation give rise to few, if any, symptoms (Table II). A dull, aching, homolateral pain in the lumbar region is the most constant complaint. One patient having a right ventromedial deformity, complicated by infection and hydronephrosis, experienced pain in the right upper abdominal quadrant which completely disappeared following nephrectomy. Hematuria is occasionally observed. The bleeding, which varies greatly in amount, can be traced universally to the affected kidney. Other symptoms are caused by some asso-

Since this paper was submitted for publication a case of left dorsal rotation came to necropsy at the University of California Hospital. A brief report of the findings is here appended through the courtesy of the Department of Medicine.

The patient, a white male 43 years of age, succumbed to aleukemic lymphatic leucemia. He had given no history of any urinary disturbance and had presented no symptoms which would direct attention to the anomaly. During his hospital stay the urine was found to contain a few red blood cells but no pus cells or organisms.

At necropsy both kidneys were found in the usual lumbar position and both showed widely exposed calyces which could be traced almost to their insertion in the parenchyma (Fig. 4). The right kidney was normally rotated but the left demonstrated a dorsal rotation. The blood vessel took a dorsal course in entering the hilum of the anoma- lous member indicating excessive rather than reverse rotation. Several cysts about a centimeter in diameter were scattered throughout its cortex.

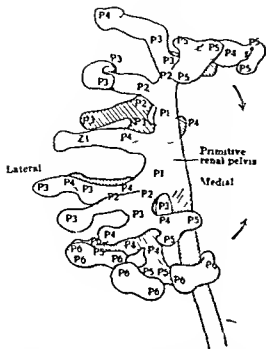


FIG. 22 Model of the right ureteral tree of a human embryo 10.4 millimeters in length seen from the front at the completion of pelvic extension. Note the embryonic type of pelvis. The early orders of tubules curve medially around the pelvis in the direction of the two arrows. This mechanism precludes the normal medial excursion of the pelvis. P and Z denote the pole and central tubules respectively. (From Felix)

ciated condition. In fact the numerous complaints which arise from the complications of anomalous rotation often direct attention to the underlying malformation.

DIAGNOSIS

Although it is possible on extremely rare occasions to palpate the hilum renale in its anomalous position in most instances pyelographic studies are necessary for an accurate clinical diagnosis. While the anteroposterior pyelogram serves to identify lateral rotation (Figs. 14 and 19) the only method of differentiating the types clinically in which the calyces overlie the pelvis is by means of lateral or stereoscopic views (Figs. 15 and 16). The greatest difficulty is encountered in recognizing ventromedial rotation because this anomaly so closely approximates the normal position of the kidney (Figs. 12 and 23).

It is important to distinguish between anomalous rotation and torsion on the longi-

TABLE II—ANALYSIS OF 19 CASES OF ANOMALOUS RENAL ROTATION¹

	Ventral rotation Cases 1 to 11	Ventromedial rotation Cases 12 to 14	Lateral rotation Cases 15 to 19	All type
Number of affected kidneys	14	4	5	23
Symptoms (from affected kidney)				
Dull abdominal pain	0	3	3	6
Empty micturition	3	1	0	4
Chills and fever	3	1	0	4
Hematuria	2	0	0	2
Pyuria and frequency	2	0	0	2
Renal colic	2	0	0	2
Complications (affected kidneys)				
Infection	5	3	1	9
Hydrocephalus	5	3	1	9
Nephroses	4	1	1	6
Ureteric calculus	1	0	0	1
Treatment (affected kidneys)				
Nephrectomy and retention	4	1	0	5
Partial resection	3	0	0	3
Nephrectomy	2	0	0	2
Pyeloplasty	1	1	0	2
Ureterostomy	0	0	0	0
Ureterolithotomy	0	0	0	0
Results (each kidney)				
Improved	9	3	3	15
Follow-up 2 months to 5 yrs				
Unimproved	5	1	2	8
Unoperated	0	0	0	0

¹The series comprises 3 cases of bilateral ventral rotation, one combined ventral of left and right and right ventromedial rotation and 15 unilateral forms.

1. Case 1, a dull pain was referred to the anterior abdominal wall over the region of the affected kidney.

2. From renal section.

3. Infection, pyuria, hematuria, 6 times; pyelocystitis 2 times; proteinuria 1 time.

4. For infected hydrocephalus, 1 time; poor renal function.

5. For infected hydrocephalus, 1 time; renal function, good; return post-operative.

6. The pyelogram revealed poor renal function.

7. For hydrocephalus and nephroses not relieved by nephrectomy.

8. For persistent hematuria, 1 time.

9. Cases 5 and 17 are included through the courtesy of Dr. W. M. Coppedge and Case 16 through the courtesy of Dr. J. F. Latex.

tudinal axis of the kidney. A pyelogram which shows the characteristics of an embryonic pelvis or discloses the presence of one of the obvious causes of torsion, such as a retroperitoneal tumor, facilitates the diagnosis. At operation or necropsy, of course the distinction can easily be made on the basis of the different pathological features of the 2 conditions.

Bilateral anomalous rotation may be mistaken for horseshoe kidney. The palpation of an isthmus, however, or the demonstration of its presence in the roentgenogram will serve to identify the latter malformation. Ectopic kidneys are easily identified by their abnormal



Fig. 23 Left ventromedial rotation complicated by hydronephrosis and infection (Case 14). Obstruction caused by aberrant artery constricting ureteropelvic junction. The pyelogram so closely resembles that of a normally rotated kidney that the diagnosis was not suspected until the renal pelvis was found located ventral to the vascular pedicle at operation (pyeloplasty).

location and short ureters. Baggio called attention to the danger of failing to recognize anomalous rotation when ptosis is present. Finally, the pyelographic picture of elongated, narrow calyces may suggest renal tumor (Fig. 19), or polycystic disease. Lateral displacement of the upper portion of the ureter is another sign which is seen in both renal tumor and anomalous rotation.

COMPLICATIONS

Renal infection and hydronephrosis each occurred 9 times in the 23 anomalies of the present series (Table II). They were associated in 5 instances, and occurred separately in 4 instances. The causative agents producing hydronephrosis were (1) bands of connective tissue which fixed the upper part of the ureter and adjacent renal pelvis to the renal parenchyma and peritoneum, preventing a

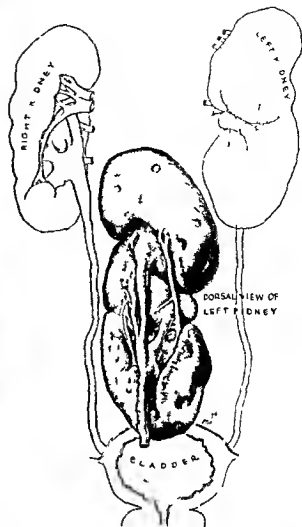


Fig. 24 Left dorsal rotation (necropsy specimen). Note the wide exposure of the calyces of both kidneys. The blood vessels on the left course dorsal to the kidney in entering the hilum indicating excessive rotation. Several cysts are seen showing through the capsule.

free pyelo-ureteral motility, a factor stressed by Herrick, de la Pena, and Raguz, (2) the compression of the ureteropelvic junction by an aberrant blood vessel, (3) congenital stricture of the ureteropelvic junction, and (4) nephroptosis producing an angulation of the ureteropelvic junction. The combined factors of nephroptosis and fibrous bands contributed to hydronephrosis in 4 instances, nephroptosis alone in 2, aberrant blood vessels in 2, and congenital stricture in 1 instance. The presence of a ureteral calculus complicated one case of non rotation, the malformation being discovered on pyelography. Dr. A. Vitale, in 1930, reported the uncommon coincidence of tuberculosis and renal tumor in anomalous rotation.

Strangulation may be a more frequent complication of the anomalies of rotation than is generally suspected. The renal bleeding in these conditions has never been satisfactorily explained. An area of strangulation too mild to evoke any symptom other than hematuria could well be produced by a transient compression or angulation of one or more of the frequently associated aberrant blood vessels. Although severe recognizable degrees of strangulation may occur in faulty rotation, as in Westerborn's patient the acute condition is more often encountered in renal torsion.

PROGNOSIS

Anomalous rotation is an abnormality which is entirely compatible with a healthy existence. As is true of any congenital renal malformation however there is an increased incidence of dangerous complications (Table II) such as obstruction and infection. The prognosis rests largely upon the nature and severity of these complications being better for a unilateral than for a bilateral anomaly. In the present series no fatality occurred although one patient was critically ill from a bilateral hydronephrosis complicating bilateral non rotation (Case 8).

TREATMENT

When unassociated with other renal abnormality the treatment of the errors of rotation is chiefly symptomatic. Some cases are discovered accidentally as during the investigation of the opposite kidney and require no treatment. Relief from renal bleeding is usually afforded by pelvic lavage with 0.5 to 1 per cent silver nitrate, physiological serum mixed with adrenalin or 30 per cent sodium iodide. Rodriguez and Ajamil reported success following the use of the 2 latter solutions. When pain over the region of the kidney is a persistent symptom nephropexy combined with pelvic ureterolysis may be carried out with a good expectancy of relief. Renal sympathectomy may also prove helpful although in the absence of a normal vascular pedicle it may be impossible to identify the sympathetic plexus.

Pyelonephritis occurring in the absence of obstruction, should be treated conservatively.

Hydronephrosis may be relieved by some form of plastic operation on the pelvis as in Case 14 and that reported by Moore, by pelvic ureterolysis or by nephropexy, depending upon the etiological factor. For advanced hydronephrosis however, nephrectomy is indicated provided the function of the opposite kidney permits (Cases 10 and 13). Acute renal strangulation as evidenced by a painful mass in the region of the kidney, hematuria, nausea vomiting and shock requires immediate exploration. If the normal color of the organ is restored by relieving the torsion nephropexy becomes the operation of choice. In the presence of gangrene nephrectomy is imperative.

It is essential that the surgeon be familiar with the pathological characteristics of the anomalies of rotation. A knowledge of the position of the pelvis obtained before operation will determine and facilitate the approach and eliminate needless manipulations. No aberrant blood vessel should be divided without preliminary compression in order to ascertain that it may be sacrificed without endangering the vitality of the kidney. If a wide area of discoloration appears on the renal surface following this maneuver the vessel must be preserved. The importance of freeing the renal pelvis and ureter from adherent fibrous bands and peritoneum is obvious. In performing a nephropexy, the anomalous rotation if deviating to any marked degree from the normal should be retained (Fig. 10) for, in most instances the conversion of this anomalous rotation to the position of a normal kidney would produce torsion of the ureter, displace adjacent intraperitoneal viscera and require the division or angulation of important blood vessels.

SUMMARY

- 1 The anomalies of renal rotation, exclusive of ectopic and fusional deformities may be divided into 4 main types (1) ventral or non rotation (rarely excessive rotation), (2) ventromedial or incomplete rotation, (3) lateral rotation (reverse or excessive rotation), (4) dorsal rotation (excessive or reverse).
- 2 The change in the position of the hilum renale which takes place during early embry

onic life results from a differential regional growth within the metanephros rather than from an actual rotation of the entire organ

3 Hypotheses concerning the etiology of anomalous rotation are advanced emphasis being placed on such intrarenal forces as the organizing activity of the ureteral tree as opposed to any extrarenal mechanical influence

4 The clinical aspects of the condition are discussed and 19 cases summarized

I wish to express my appreciation to Dr Edwin P Alyea Dr Frank Hinman and Dr John B deC M Saunders for their valuable assistance in the preparation of this paper

BIBLIOGRAPHY

- 1 BAGGIO C Ectopia del rene nella regione lombare *Folichin* 19 3 10 603-614
- BOYDEN E A Congenital absence of the kidney An interpretation based on a 10 mm human embryo exhibiting unilateral renal agenesis *Anat Record* 1932 52 3 323-339
- 3 BRAASCH W F Anomalous renal rotation and associated anomalies *Tr Am As Genito-Urin Surg* 1930 73 1-1 *J Urol* 1931 5 0-1
- 4 BREMER J L The origin of the renal arteries in mammal and its anomalies *Am J Anat* 1915 18 1, 9-20
- 5 BROWN A L An analysis of the developing metanephros in mouse embryos with abnormal kidneys *Am J Anat* 1931 47 117-127
- 6 CAMPBELL M F *Pediatric Urology* P 1 New York The Macmillan Company 1937

- 7 DREW A H Cultivation of tissues and tumors in vitro *Lancet* 19 1 1 1-1
- 8 FELLIX W The development of the urogenital organs In Keibel F and Mall F L *Manual of Human Embryology* Vol 1 Philadelphia and London Lippincott 1921
- 9 HARRIS F C Trauma as a factor in the etiology of hydronephrosis (pyelectasis) *Tr Am Urol Ass* 1929 1 1-6
- 10 HINMAN F The Principles and Practice of Urology P 1 0 1924 Philadelphia Saunders 1931
- 11 LABRY C and PARIS J Kéistiepieue congénitale pour une tumeur du mésentère *J diurol* 1914 7 763-773
- 12 MOORE T D Congenital solitary hydronephrotic infected kidney *J Urol* 1912 2 51-59
- 13 NICHOLSON C W The kidneys and development *Clin-Urology* 19 7 7 36-38
- 14 PARIS E *Chirurgie du Rein* Vol 1 p 101 Paris Caeton Douin et Cie 1925
- 15 PENN A DE LA et KUTZ K Torsion renale congenitale *J diurol* 1934 15 13 6
- 16 PRIMAN J A consideration of normal and at normal position of the hilum of the kidney *Anat Record* 19 9 4 353-361
- 17 RODRIGUEZ MOLINA I F and AYALA I I Three cases of torsion of the kidney *An de cir* 1930 150
- 18 SPRENGER H Organizers in animal development *Proc Roy Soc London Series B* 19 10 17
- 19 STEINMANN H and EILERSBERG H Ueber asymmetrische Entwicklung und Situs inversus viscerum bei Zwillingen und Doppelbildungen *Arch f Entwicklungsmech d Organ* 1910 45 171-4
- 20 VITALI A Le anomalie renali *Folichin* 1930 37 43-56 16-56
- 21 WESTERBORN A Renal torsion and abnormally coursing renal vessels *Acta chirurg Scand* 1931 65 5



Fig 4 Albee reconstruction

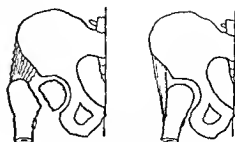


Fig 5 Colonna reconstruction

tabulum the abductor muscles being anchored in a bed lower down on the shaft (Fig 5) Magnuson implants the reshaped neck in a bed in the head and also transplants the greater trochanter with attached muscles lower (Fig 6) Brackett places the proximal end of the distal fragment of an intertrochanteric osteotomy into a similar bed in the head (Fig 7) As all of these reconstructions are less shocking than the bone graft procedure they have their place when chosen for individuals not in physical condition to tolerate the major procedure. The placement of cancellous bone of the neck against the acetabular cartilage however is very prone to cause irritation and subsequent arthritis.

The frequency of this pseudo arthrosis in elderly patients leads one to consider palliative procedures. Will these simpler less traumatizing osteotomies produce stable painless hips? The osteotomy of Lorenz aims at placing a portion of the femoral shaft under the head itself thus passing the weight bearing stresses directly to the head instead of through the medium of the pseudo arthrosis (Fig 8) Schanz described two osteotomies a high and a low. In this pathological entity, we are concerned only with the high type which is

performed in the intertrochanteric region but for the explicit purpose of markedly abducting the distal fragment if the head is movable. When bony union occurs between the femoral shaft fragments in this position and the leg adducted to neutral for weight bearing the proximal fragment accompanies the distal which changes the pseudo arthrosis fracture line from its original vertical position with severe sheering stresses to one more or less horizontal with associated pressure stresses (Fig 9) This static change may produce late bony healing of the pseudo arthrosis as was observed by Schanz and later explained by Pauwels on the basis of Roux's law (13).

Occasionally all operative procedures may fail either because of technical errors or because of shortcomings of the procedures. The final solution is an arthrodesis of the hip joint (Fig 10) Gill advocates the use of this procedure at an early stage even 4 months after institution of conservative treatment with failure to obtain bony union. At first glance this view may be condemned as being too radical but it does decrease the temporary disability and quickly replaces the individual at his occupation a point of great importance in the laboring class on whom a pseudo

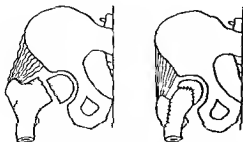


Fig 6 Magnuson reconstruction

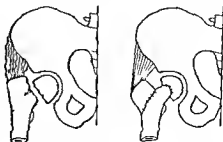


Fig 7 Brackett reconstruction

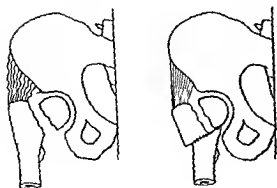


Fig. 8 Lorenz osteotomy

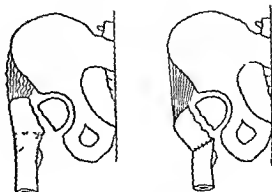


Fig. 9 Schanz osteotomy

arthrosis of the femoral neck places great financial strain. An arthrodesed hip joint in good position allows the individual to do almost everything easily except lace his shoe, some acquire even this ability. The operative trauma, however, is more severe than that associated with palliative procedures, hence this type of surgery must be reserved for individuals in at least fair general condition.

A large number of patients because of election or poor physical condition must be treated conservatively. In this category falls physiotherapy, crutches, canes, braces, and pelvic belts, or combinations of these. A properly fitted caliper brace with well fitted Thomas ring for ischial weight bearing relieves the pseudo arthrosis of sheering stresses. The pelvic belt by its tight compression forces the femora against the ilia, thereby reducing the upward glide of the hip at each step to a minimum. Inductotherm heat has a direct effect on associated arthritic changes.

The following statistics are a composite from the Orthopedic Departments of the Universities of Iowa and Nebraska, division is made according to the type of treatment instituted.

Open reduction with use of Albee bone graft was used in 5 cases—4 males and 1 female, whose average age was 43 years, and who were observed an average of 3.6 years. The results were good with bony union, good motion, no pain in 1 patient, fair with bony union, limited motion, and slight ache in 2 patients, and poor with non union in 2 patients.

Thus only 60 per cent favorable end-results were obtained. A sixth case seen after having

the graft procedure performed elsewhere with a good bony fracture union, had a stiff hip from the extra articular bone production, doubtless produced by the stripping and dissection necessary for adequate exposure of this area.

Open reduction with use of the Smith Petersen nail was used in 2 cases, 2 males, 28 and 51 years of age respectively. Average observation was 17 months. One head fragment was necrotic. The results were poor with non union and increasing varus in both cases. The inefficiency of nailing would seem well illustrated in these 2 cases.

The Whitman reconstruction was done in 18 cases, 5 males, 13 females. The average age was 54 years, average observation, 3.6 years. Three head fragments were necrotic. The results were good with no support needed, useful motion, stable, occasional slight ache in 5 cases, fair with cane necessary, motion slightly limited, occasional slight ache in 4 cases, and poor with crutches necessary, unstable, severe pain or no motion in 9 cases.

The large number of failures, 50 per cent, must be ascribed to the method itself, which

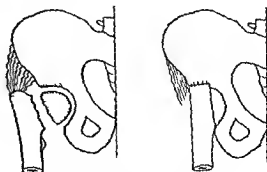


Fig. 10 Arthrodesis of hip joint

aims at restoration of painless motion with stability. Three of the poor results are due to spontaneous bony ankylosis late after operation which even though serving as stable painless hips must be classified as poor Whitman reconstruction results.

The Brackett reconstruction was used in 3 cases, 1 male, 2 females. The average age of patients was 41 2 years, average observation, 1 2 years. One head fragment was necrotic. The results were good with no support necessary, useful motion no pain in 1 case, poor with pain or instability in 2 cases.

Of the two poor results one was due to a technical error, the other to osteoarthritis.

The Lorenz osteotomy was performed in 9 cases, 1 male, 8 females. The average age was 62 years, average observation, 5 4 years. The results were good with no support necessary, motion adequate to tie shoe, slight ache in 2 cases, fair with cane necessary, occasional pain in 2 cases, and poor with pain marked in 5 cases.

The preponderance of poor results is caused by four technical errors as demonstrated by roentgenograms showing the osteotomy sites either too high or too low or the distal fragments improperly placed under the head in all fairness to the method, these errors must be excluded which produces 80 per cent favorable end results.

Schanz osteotomy was done in 3 cases, 2 males, 1 female. The average age was 57 years, average observation 3 3 years. The results were good with no support necessary, no pain, adequate motion in 1 case and fair with no support necessary, occasional slight ache, and restricted motion in 2 cases. Late bony union was not observed.

In 1 case fusion of the hip was done. The patient was a female, age 37 years, observed 3 4 years. The head fragment was living. The result was good.

In the same category may be placed three of the poor Whitman reconstructions which however, served as good arthrodesed hips. Functionally these cases had excellent results. The disability connected with an arthrodesed hip joint in 20 degrees of flexion and with neutral abduction and adduction is about 20 to 25 per cent of the entire leg.

The tuber seat brace was used in 13 cases, 6 males, 7 females. The average age was 64 years, average observation 1 5 years. Four head fragments were necrotic. The results were good with no additional support necessary in 3 cases, poor with additional support necessary in 10 cases.

A pelvic belt and physiotherapy were used in 13 cases, 5 males, 8 females. The average age was 66 years, average observation, 1 7 years. Two head fragments were necrotic. The results were good with no additional support necessary in 2 cases and poor with added support necessary in 11 cases.

Twenty four cases were unsuitable for treatment and of these 7 head fragments were necrotic.

CONCLUSIONS

- 1 The bone graft procedure of Albee is a radical surgical procedure producing only 60 per cent good results in this series. Its use in individuals of advanced years or with arthritic changes in the hip would seem to be contra indicated. Certainly the surgeon must be adept and efficient to obtain best results in this procedure.

- 2 Open reduction and fixation with the Smith Petersen nail is not adequate for a pseudo arthrosis with a head fragment markedly atrophic or definitely necrotic. Its use should probably be restricted to treatment of fresh fractures.

- 3 The Whitman reconstruction which produced 60 per cent favorable end results is too often followed by late osteo arthritic changes with associated pain and by instability due to laxation.

- 4 The Brackett reconstruction producing 33 1/3 per cent good results is technically more difficult than the Whitman procedure.

- 5 Both Lorenz and Schanz osteotomies are excellent selections in altering the static stresses about the femoral neck. These procedures are not as severe as any of the reconstructions but offer technical difficulties. Excluding technical errors, end results were favorable in 87 per cent of cases.

- 6 Operative fusion of the hip is a radical but sound procedure especially in individuals of the laboring class where quick return to work and stability are essential.

7 As stressed by Brackett, individual case study is necessary in an attempt to determine the procedure the individual will best tolerate and that gives due consideration to his local physical assets, anatomical and physiological. A plan of attack suggested is as follows:

A If patient's general condition is good with (1) the head living, open reduction, fixation with bone graft should be done (2) with head necrotic and (a) neck present, reconstruction of Albee or Whitman is method of choice, (b) if neck is absent, reconstruction of Colonna type should be done (3) If osteoarthritis is marked, fusion of hip joint is method of choice.

B If general condition is fair with (1) head living, reconstruction of Brackett or Magnuson type, (2) with head necrotic, osteotomy of Lorenz or Schanz, should be used.

C If patient's general condition is poor whether head is living or dead the treatment is (a) osteotomy of Lorenz or Schanz or (b) support alone.

BIBLIOGRAPHY

- 1 ALBEE F H Late end results in ununited fracture of neck of femur *J Bone & Joint Surg* 1923, 10 124
- 2 BRACKETT E G Fractures of neck of femur Boston M & S J 19 5 192 1118
- 3 CAMPBELL W C Fractures of neck of femur *J Am M Ass* 1923 81 1227

- 4 CHANDLER S B and KREUSCHER, P H A study of blood supply of ligamentum teres, etc *J Bone & Joint Surg* 1932, 14 834
- 5 COLONNA, P C A reconstruction operation for fractured neck of femur *J Bone & Joint Surg*, 1935, 17 110
- 6 COOPER ASTLEY Dislocations and Fractures 1st ed London John Churchill 1822
- 7 GILL, A BRUCE Treatment of fractures of neck of femur *Ann Surg*, 1932, 96 1
- 8 HENDERSON, M S and MACEY H B Treatment of fractures of neck of femur *Surg Clin N America*, 1935 15 1109
- 9 LORENZ A Ueber die Behandlung der irreparablen angeborenen Hüftluxationen und der Schenkelhals-Pseudoarthrosen mittels Gabelung *Wien klin Wchnschr* 1919 32 997
- 10 MAGNUSON P B Fractures Philadelphia J B Lippincott 1933
- 11 PAGWEL, FRIEDRICH Der Schenkelhalsbrücken ein mechanisches Problem P 6 Stuttgart Enke, 1935
- 12 PREMISTER D B Fractures of neck of femur, etc *Surg Gynec & Obst* 1934 50 415
- 13 POUX, VON WILHELM Gesamte Abhandlungen und Entwicklungsmechanik der Organismen 1 357 Leipzig Wilhelm Engelmann 1895
- 14 SANTOS, JOSE V Changes in head of femur after complete intracapsular fractures *Arch Surg*, 1930 21 470
- 15 SCHANZ A Ueber die nach Schenkelhalsbrücken zurück bleibenden Gehstörernngen *Deutsche med Wchnschr* 1925, 51 732
- 16 SMITH PETERSEN, M N CAVE E F and VAN GORDEL G W Intracapsular fracture of neck of femur *Arch Surg* 1931 23 715
- 17 SPEED, KELLOGG The ununited fracture *Surg Gynec & Obst* 1935 60 341
- 18 WHITMAN, ROYAL The operative treatment for ununited fracture of the hip *Surg Gynec & Obst*, 1926 83 211
- 19 WOLCOTT W E Circulation of head and neck of femur *J Am M Ass*, 1933 100 27



Fig. 1

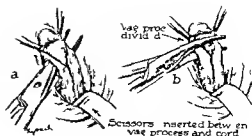


FIG. 4

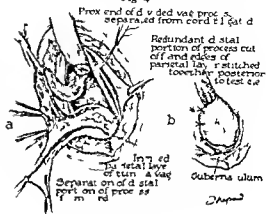


Fig. 5

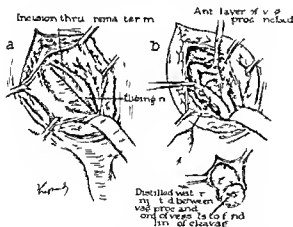


Fig. 3

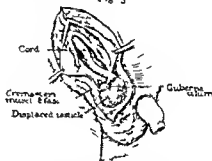


Fig. 6

Fig. 1. Anatomy of congenital type of hernia into the processus vaginalis.

Fig 2 The cremaster muscle and fascia is shown covering the lateral and anterior surfaces of the cord and testicle. This structure may completely envelop the testicle. The relationships of the sac in congenital type of hernia are also shown.

Fig 3 a Incision through the cremaster muscle in order to expose the cord and peritoneal sac. The fascia of the external oblique has been incised and its leaves retracted. Care should be exercised to avoid the ilio-inguinal nerve. In indirect inguinal types of hernia the peritoneal sac is never found outside the cremaster muscle. b Injection of

fluid between the peritoneal process and the cord in order to facilitate dissection. Either water or normal saline solution may be used. Injection should be done after the sac is opened.

Fig 4 Method of separation of the sac from the cord by blunt dissection. This may also be accomplished by incision with a knife from the peritoneal side through the injected area.

Fig. 5 a The proximal end of the divided sac has been separated from the cord and ligated as high as possible. The lower portion is dissected to the level of the epididymis. b The distal portion of the sac has been everted as in the bottle type of operation. Some surgeons prefer to invert this portion of the sac; others do not disturb it but allow it to drop back unsutured.

Fig. 6 It is essential to replace the testicle within the cremaster muscle. This may be difficult. The testicle is here shown improperly placed outside of the cremaster muscle. The opening in the muscle is not usually as clearly defined as in the drawing.

CLINICAL SURGERY

FROM THE MILWAUKEE CHILDREN'S HOSPITAL

TECHNICAL NOTES ON CONGENITAL INDIRECT INGUINAL HERNIA

STANLEY J. SEEGER, M.D., F.A.C.S., Milwaukee, Wisconsin

THE surgical treatment of congenital inguinal hernia presents several technical problems two of which deserve discussion. The first of these is the anatomy of the hernial sac and the technique of removing it from the spermatic cord. The second is the anatomical relationships of the cremaster muscle, the hernial sac, the testicle and the spermatic cord. Failure to observe the importance of these relationships may lead to malposition of the testicle following operation.

The term 'congenital hernia' does not refer to the fact that a hernia exists at birth. It describes the type of hernia in which the congenital pouch of peritoneum, which precedes the cord and testicle in its descent, remains patent throughout and unclosed at any point. In congenital hernia the tunica vaginalis communicates directly with the cavity of the peritoneum so that the peritoneal contents may descend within this sac and lie in contact with the testicle. Normally, the processus vaginalis, which is patent for a month after birth in about 50 per cent of infants, soon becomes occluded by adhesion or zygozosis at two points. The upper point of occlusion takes place at the internal abdominal ring, and the lower point at a short distance above the testicle. According to Keith, in 30 per cent of children, occlusion takes place at the internal abdominal ring some considerable time after birth or it fails altogether, in which latter case the sac of a true congenital type of inguinal hernia exists. This is in accord with our experience at the Milwaukee Children's Hospital where approximately one third of the cases of indirect inguinal hernia are of the congenital type.

In dealing with this type of hernia it is necessary to divide the sac. This is done at approximately the middle. The upper portion is then separated from the spermatic cord and is treated as is the sac in scrotal types of hernia. The lower

portion of the sac is variously treated by surgeons. Some surgeons treat the sac as a hydrocele sac, some fashion a new tunica vaginalis while others do not touch the lower portion of the sac, but allow its divided end to drop back unsutured. The sac is often rather firmly attached to the cord, and in many instances the peritoneum is a very friable structure. Many years ago Bevan suggested that in these cases the dissection of the peritoneum from the cord could be made much easier by the injection of fluid, either water or normal saline solution, between the peritoneum and the struc-

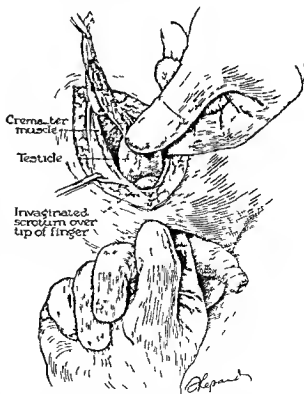


Fig. 7. Inversion of the scrotum over the index finger in order to insure proper replacement of the testicle within the cremaster muscle and fascia.

tures of the cord. This is best done after the sac has been opened, and the posterior layer of the peritoneum which is adherent to the cord, can be visualized readily. The incision may be made either from the outer side of the sac or from the peritoneal side.

The cremaster is a thin muscular layer which is composed of a number of fasciculi which arise from the middle of the inguinal ligament where these fibers are continuous with those of the internal oblique and also occasionally with the transversalis. These fibers are picked up by the scrotum in its descent to the scrotum from the lumbar region. The cremaster muscle passes along the internal side of the spermatic cord, descends with it through the external inguinal ring, lies upon the front and sides of the cord, and forms a series of loops which are united by areolar tissue. The thin covering over the cord and testicle is the cremasteric fascia. At times it completely surrounds the testis and cord. The fibers are inserted by a small pointed tendon into the tubercle and crest of the pubis bone and into the front of the head to the rectus abdominis. Ogilvie has recently commented on the physiology of the cremaster muscle stating that this structure is "the most maltreated by surgeons." In indirect forms of inguinal hernia the sac is never found outside the cremaster muscle and fascia. In congenital type if one treats the lower half of the sac as a hydrocele or kistion, a very thin vaginal sac is necessary to deliver the testicle through the opening which has been made in the cremaster muscle.

After the sac has been treated either by everting or as in the best type of operation for hernia, or by eversion and the formation of a small vaginal process one may find this is difficult to replace the testicle within the cremaster. Forceful efforts to replace the testicle within the scrotum may result in its placement outside the cremaster muscle. This technical error will lead to subsequent malposition of the testicle usually on the pubic bone with consequent discomfort. Should the opening in the cremaster not be located readily and if it is any kind be experienced in replacing the testicle within the scrotum, the proper channel can be found easily by inverting the scrotum over the tip of the finger. This maneuver obviates the possibility of error. At the conclusion of the operative procedure the scrotum should again be examined to make sure that the testicles are in their normal position.

BIBLIOGRAPHY

1. BRIDGES, ARTHUR DEAN. A remedy of the radical cure of indirect inguinal hernia, (personal communication) and experimental. Proc. L. S. S. Soc. Phila. Grad. Med. Sch., 1927, October 12-13-14.
2. CHAMBERLAIN, C. L. *Genital and Urinary Pathology*. V. B. Saunders Co., 1923.
3. GRAY HENRY. *Anatomy of the Human Body*. 3rd ed. Philadelphia: Lea & Febiger.
4. KERN, S. J. *Urology*. Human Anatomy and Physiology. 2nd ed. Baltimore: William F. and Co., 1927.
5. OGDEN, W. H. The fate of plumbago in clinical urology. Proc. S. S. S. Soc. Phila. Grad. Med. Sch., June 21, 1927.

THE TREATMENT OF THORACIC EMPYEMA

A. L. d'ABREU, Ch M., F.R.C.S., Cardiff, Wales

THE technical details of empyema drainage are simple: the chief responsibilities of the surgeon are to determine when, where, and for how long to drain. If the chest is opened too soon especially for synpneumonic empyema the vital capacity already decreased will be further lowered by severe mechanical disturbances of the mediastinum which follow the creation of an open pneumothorax before the abscess has localized or the central structures have become fixed by adhesions. Brock¹ has also demonstrated that the entry of air to the pleural cavity encourages absorption of pleural fluids if the effusion is purulent, the toxemia is thereby increased. Sudden decompression by the withdrawal of large quantities of fluid may cause death. If, however, drainage is postponed too long, thickening of the visceral pleura and prolonged collapse of the lung will delay that expansion of the lung which is so necessary for obliteration of the empyema cavity. The correct moment for drainage is when the pus is moderately thick. Acute empyema in infants causes a fairly high mortality rate partly because of the extreme mobility of the diaphragm and because of too early drainage by open operation.

PREPARATION

Pleural puncture and aspiration. Since empyema is never an acute surgical emergency, the preoperative management can be carried out deliberately. Our first duty is to ascertain the type of pleural exudate and its bacteriology by paracentesis. A common error is to allow air into the chest during the aspiration of the fluid (whether done for diagnostic or therapeutic reasons) and this is due to slovenly technique.

METHOD

Diagnostic puncture. If the empyema is basal the patient is propped up and leans forward on pillows or a cardiac bed rest. In nervous subjects a sedative is employed and no hesitation is felt about using morphia in reasonable doses. The skin overlying the intercostal space is infiltrated

with 1 per cent novocain and then the deeper tissues including the parietal pleura through the hypodermic needle mounted on a 2 cubic centimeter record syringe. After full anesthetization the same needle is advanced into the pleural cavity. If the purulent fluid is thin it will be drawn easily through the hypodermic needle. If no fluid is obtained the pus is probably thick and a larger needle on a syringe is employed and a sample of pus is withdrawn and examined bacteriologically. Under no circumstances is the barrel of the syringe disconnected while the needle is in the pleural cavity, as air would thereby enter.

Therapeutic aspirations. These are performed under local anesthesia in this clinic a two way syringe of the Dieulafoy type (Fig. 1) is preferred to a Potain aspirator or a reversed artificial pneumothorax apparatus. The apparatus is assembled as shown in Figure 1, and the needle introduced into the pleural cavity. The plunger is withdrawn until the barrel of the syringe is full and then the two way tap is turned and the pus is expressed into a receiver. The maneuver is repeated until sufficient pus has been removed. The onset of cough or dyspnea is an indication to cease aspiration.

The disadvantages of repeated aspiration. In nervous patients repeated skin anesthetizations are undesirable and the needle tracks may get infected. The simple operation advised by Tudor Edwards is extremely valuable in such conditions. Under local anesthesia a segment of rib is resected subperiosteally and the wound is lightly packed with flavine gauze. When aspiration is required the gauze is removed and the pus is evacuated by a two way syringe: the procedure is quite painless. After an interval the pus becomes thicker and then the pleura is incised and continuous tube drainage is instituted.

INTERCOSTAL DRAINAGE

Repeated aspiration of thin streptococcal effusion in ill patients may be too disturbing or fail to control the toxemia and the pressure disturbances, and closed air tight intercostal drainage is then desirable. This is usually accomplished

¹Brock, R. C. Observations on pleural absorption. *Brit. J. Surg.* 1933-34 21: 650.

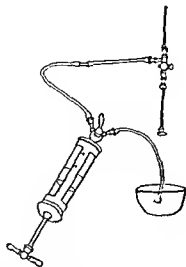


Fig 1 Two way syringe used for therapeutic paracentesis. The trocar is shown partly withdrawn.

by passing a trocar and cannula through an anesthetized area into the pleural cavity the trocar is then withdrawn and a self retaining catheter of the de Pezzer or Malecot type is inserted by means of the appropriate introducer. In this clinic the following simple maneuver has proved useful and efficient.

Preliminary treatment. The patient need not be moved to the operating theater. A preliminary

sedative such as morphia is given and the chest wall is sterilized in the usual manner. The patient leans forward on pillows or a cardiac rest.

Apparatus required. (1) *The trocar.* The one employed is that designed by Hamilton Bailey for use in performing suprapubic cystostomy.¹ (Fig 2) (2) *The catheter.* This is of the Malecot type and has a specially reinforced tip (Fig 2). (3) *The drainage bottle.* The whole apparatus is assembled as shown in Figure 3. The sterilized catheter is connected by a hollow glass tube to a length of rubber tubing which is attached to a long glass tube leading through a perforated rubber bung to antiseptic fluid in the bottom of the bottle. This is to ensure a water sealed drainage system; a smaller glass tube allows air and gas to escape from the system.

The operation. The overlying skin and pleura are thoroughly anesthetized with novocain 1 per cent solution. After the pleura has been infiltrated the needle is advanced through it still connected to the barrel of the syringe. The plunger is then withdrawn and the escape of pus will confirm the choice of site for drainage. A small incision is made through the skin. The trocar is passed through the tip of the catheter which has been assembled to the drainage bottle in order to prevent the entrance of air into the chest at any stage of the operation. The

¹The trocar and catheter used with it are made by the Genitor-Uinary Manufacturing Co. Ltd. W. I.



Fig 2

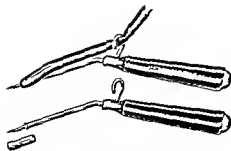


Fig 2 Hamilton Bailey's suprapubic cystostomy trocar and Malecot's catheter (above).

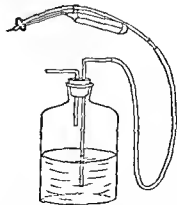


Fig 3 Trocar, catheter and bottle assembled and ready for use in performing intercostal drainage.

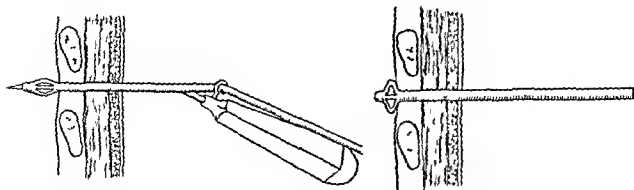


Fig 4 a left The trocar and catheter after the parietal pleura has been punctured b, After with-
drawal of the trocar

catheter is stretched out along the trocar to flatten out the flange (The metal cuff at the base of the bayonet point will prevent the trocar from perforating the catheter tip too far) The trocar is pushed into the pleural effusion until the flange is past the parietal pleura The catheter is then allowed to relax so that the rubber flange opens out and is left fitting snugly against the parietal pleura when the trocar has been withdrawn (Fig 4) Pus can now flow out of the chest without loss of the negative intrapleural pressure This will be demonstrated by observing the rise and fall of the fluid in the long glass tube with each respiratory excursion This

method is not to be used as a substitute for formal rib resection and drainage except occasionally in children Its main employment is as a preliminary to rib resection and in the management of secondarily infected tuberculous effusions

Disadvantages of intercostal drainage The tube may become blocked by fibrin clots and will easily slip out of the chest unless fixed to the skin by a silkworm gut suture If the pus ceases to flow out, the tube should be "milked", if this fails the patency of the tube should be tested by passing a gum elastic bougie or a metal stylet along it. Repeated blockage by fibrin clots indicates the necessity for rib resection and drainage

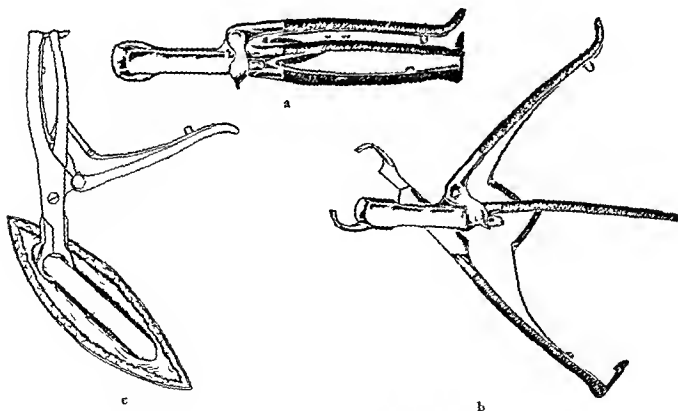


Fig 5 a and b Tudor Edwards' costotome c The costotome in position and about to divide the rib

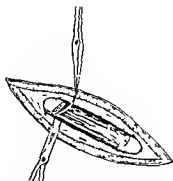


Fig 6 Excision of segment of intercostal nerve after rib resection to prevent postoperative pain

RIB RESECTION AND PLEUROTOMY

The advantages and disadvantages of closed and open drainage will be discussed later. When the pus is creamy no time should be lost in carrying out rib resection and pleurotomy. The patient is preferably placed lying on the sound side with the front of the thorax supported by a chest piece padded with sorbo rubber or supported by pillows and sandbags; the head and upper part of the thorax are well raised by pillows. The operation is usually carried out under local anesthesia in very nervous patients or young children gas and oxygen is administered.

Site for resection. The site for resection depends entirely on the situation and size of the empyema. In basal empyema the commonest site is just above the lowest level of the cavity in the mid axillary line. If the tube be placed too low the ascent of the diaphragm (which usually follows drainage) will block the tube. The ninth rib is certainly the lowest that should be chosen and usually better results follow removal of portions of the seventh or eighth ribs. If the opening is further forward than the midaxillary line the pus will gravitate further backward and escape evacuation if the tube is too posterior the position of the patient as he lies in bed will block the tube if (as is usually the case) closed drainage methods are employed. Moreover the investigation of chronic empyema sinuses shows that the posterolateral part of the lung is usually later in expanding than that occupying the costovertebral sulcus. Apical empyema cavities are drained anteriorly or in the axilla while interlobar empyema cavities are drained according to their anatomical location by anteroposterior, lateral and oblique roentgenological views.

The incision. An incision (about $2\frac{1}{2}$ inches) that is oblique rather than along the line of the

rib is preferred for the following reasons: (1) The muscle fibers can be split along the direction of their fibers, and this prevents the tendency for cellulitis or suppuration to proceed along muscular planes; and (2) the tube lies more comfortably since in an incision along the line of the rib the skin opening frequently does not correspond accurately with the opening made in the pleura after rib resection.

Before the periosteum over the rib is incised the empyema is needled to confirm the presence of pus directly beneath the space to be opened. If the needling shows that an error in choice of rib has been made, an oblique incision can readily be enlarged either up or down and another space needed. The periosteum of the rib is incised for 2 to 3 inches and then cleared by a Faraboeuf's raspatory. It is unnecessary to emphasize the well known rule that when the periosteum is cleared from the ribs the operator should work along the line of the intercostal muscles; i.e. in clearing the upper edge the raspatory passes from behind forward and in reverse direction when clearing the lower edge. A Doyen's raspatory clears the periosteum from the deep surface of the rib. Two inches of rib are then removed by means of bone cutting forceps or better by using a costotome of the Vermehren type (that illustrated is devised by Tudor Edwards, Fig 5).

The intercostal nerve. A common complaint by the patient after rib resection and drainage is pain which radiates anteriorly along the course of the intercostal nerve and this is due to the pressure of the tube. To prevent this the nerve is exposed by blunt dissection of the neurovascular bundle after the rib has been resected. A suitable portion is then excised (Fig 6). We have found this little addition to the operation to be of great benefit.

PLEUROTOMY

The posterior periosteum and the pleura are incised and the cavity is explored with the finger to make sure that the tube will be near the bottom of the cavity. In pneumoecoccal post-pneumonic empyema large fibrin clots may require removal with forceps as otherwise they will block the drainage tube. Unless the pus is exceptionally thick closed drainage is always employed. The reasons for this are: (1) that it enables a negative pressure to be established in the thorax and thus greatly aids the rate of pulmonary expansion; (2) that it does away with the necessity for frequent and disturbing changes of dressings; and (3) that it allows the cavity to be irrigated without disturbing the patient appreciably. The Tudor

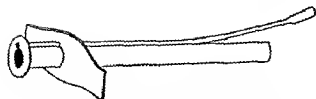


Fig 7 Tudor Edwards' tube for closed drainage

Edwards' type of tube is used (Fig 7) and the muscles are sutured around this to ensure air tight drainage and to anchor it firmly. After the wound has been lightly closed with interrupted silk worm gut sutures, the outer flange of the tube is fixed in place with elastoplast strips (Fig 8) and connected to a bottle, as after intercostal drainage, and a clip is placed on the small irrigation tube.

Postoperative care The patient is propped up in bed immediately on returning to the ward and from the outset is encouraged to breathe deeply. Great assistance in this respect is obtained by the use of breathing exercises conducted twice daily under the care of a masseuse. As soon as possible the patient is encouraged to drink and eat normal food to remove the atmosphere of invalidism. On the next day the empyema is washed out with Dakin's solution. This irrigation prevents the tube from being blocked and is a powerful dissolver of fibrin and so prevents a thick deposit of fibrous tissue developing over the visceral pleura which might delay lung expansion. If there is a bronchopleural fistula, irrigation is not employed, such a complication is detected at once if the patient says that he can taste the fluid or if he coughs violently as soon as the irrigation is commenced. If the tube becomes blocked a stiff gum elastic bougie is passed down the rubber tube, if this together with irrigation fails to produce a clean passage the tube is taken out and the wound is searched for fibrin clots which are removed and the tube is re inserted.

When to remove the tube The cavity requires a drainage tube until the lung has completely expanded out to the chest wall. The commonest cause of a chronic empyema is premature removal of the tube. If the closed drainage system is working adequately and pus is escaping, the system can be maintained for weeks or months. The safest method of estimating lung expansion is by means of a roentgenogram taken after lipiodol has been allowed to run into the tube with the patient lying on his sound side. By this means the exact boundaries of the cavity can be delineated and faulty positions of the tube noted and corrected (The tube may require lengthening or shortening). In many patients the closed

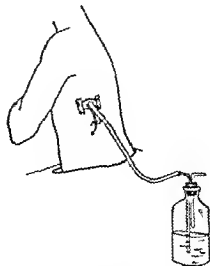


Fig 8 Closed drainage system

drainage system can be dispensed with in about a fortnight, and an open tube substituted and the pus allowed to flow out on to the dressings. The advantage of such a conversion is that the patient can be allowed to get out of bed. If, however, the lung is slow to expand, a continued use of the closed drainage together with the application of suction drainage is indicated. Even with cases of long standing chronic empyema (the treatment of which cannot be described here) re drainage by this method may be so effective that thoracoplasty and other measures can be avoided.

PROGNOSIS

In previously healthy adults the prognosis of acute empyema is very good provided the cause of the empyema is a straightforward pneumonia and not a result of generalized septicemia and pyemia. Empyema secondary to bronchiectasis and lung abscess is a grave complication and is often a terminal event in carcinoma of the lung or esophagus. From time to time empyema may be the outstanding feature in bronchial obstruction due to innocent or malignant tumors of the bronchus, and the investigation of chronic empyema fistulas should include the appropriate investigation of such causes (bronchoscopy, lipiodol bronchography). Occasionally a patient is referred with a diagnosis of empyema when the true condition present is that of suppurating congenital cyst of the lung. Empyema is a serious condition in infants under the age of two and in elderly patients. Though possessing peculiar risks of its own, bilateral empyema can frequently be managed with complete success, each side being treated strictly on its own merits, open drainage being used only when the pus is thick.

CONSERVATIVE MYOMECTOMY

Professor BERNHARD ZONDEK Jerusalem Palestine

In the gynecological literature the question is discussed again and again as to whether in operating on a myoma supravaginal amputation of the uterus or total extirpation should be performed. This question however, should be considered only in women past the menopause in the childbearing period total extirpation should not enter into the discussion. The surgeon is obliged to carry out his operations in as conservative a manner as possible in order to maintain menstruation in the woman.

For a considerable time operative gynecology was ruled by the assumption that menstruation is an unphysiological process. As long as we placed the ovum in the center of the generative processes menstruation—as the expression of the death of the ovum—was considered as an unimportant and unphysiological occurrence. Experimental investigations (3, 4, 6) however demonstrate that the ovum in itself has no importance in the hormonal regulation of the ovarian functions, that the ripening of the follicle and the production of folliculin, luteinization and progesterone production are independent of the ovum. The function of propagation is dominated by the anterior pituitary; for without the anterior pituitary and without the gonadotropic hormone the ripening and the rupture of the follicle is not possible. Without the anterior pituitary the ovum would never unite with the spermatozoon. It is not the ovum but the anterior pituitary that dominates the whole generative process; it governs the follicle with its enclosed ovum as well as the ovarian hormones (estrone and progesterone) produced secondarily in the follicular cells. The task of the ovum during its presence in the ovary is exclusively that of preparation for fertilization. The ovum however does not participate in the constructive process of the uterine mucosa necessary for its nidation. This latter is brought about by the ovary under the influence of the anterior pituitary.

Based upon this biological knowledge we can no longer consider menstruation as did Robert Meyer in a certain respect as a pathological process but on the contrary as a process specifically intended by nature for the case when the

ovum is not fertilized. In most of the mammals the generative cycle occurs without bleeding. It cannot be accidental or unintentional that in primates this process is accompanied by bleeding. Although hitherto we have been unable to explain the meaning of menstruation in a physiological sense we must not conclude however that our insufficient knowledge should compel us to disregard the importance of menstruation. There is one property of the menstrual blood which distinguishes it in a characteristic manner from the remaining corporal blood: that is its incapability to coagulate. If we consider menstruation as a pathological process not intended by nature it is incomprehensible why menstrual blood should have other properties than the corporal blood. The concentration of follicular hormone in the menstrual blood is seven times as high as it is in the blood of the general circulation (R. T. Frank and Goldberger). Menstrual blood therefore participates in the excretion of folliculin which has not been used by the organism. Menstrual blood does not coagulate for otherwise it would form a large clot in the corpus uteri and would impede the cleansing of the uterus, i.e. the discharge of the uterine mucosa during menstruation. If therefore menstrual blood demonstrates its purpose by its inability to coagulate the discharge of the blood in itself, i.e. menstruation, must have a physiological importance. Menstruation is not a passive but an active process induced by special hormonal action probably by a hemorrhagic substance (5). The discharge of menstrual blood has in addition, as every physician knows, a very great psychic importance. These facts should teach gynecologists to proceed as conservatively as possible in operative manipulations in order to maintain wherever possible the menstrual hemorrhage in women of a sexually mature age.

There should be no discussion of the question as to whether in operating upon a myoma the uterus should be amputated supravaginally or totally extirpated. The supravaginal amputation should be preferred and performed as high as possible in order to preserve a part of the uterine mucosa from which menstruation may take place. If however for technical reasons (if for example the whole uterine wall is involved

by the myoma), the supravaginal amputation cannot be performed, the uterine mucosa should be implanted in the cervix following the low supravaginal amputation in order to give the uterus the possibility of menstruating. Even in women near or beyond the menopause supravaginal amputation is advisable because in this manner the configuration of the vagina is better preserved and difficulties in coitus are eliminated, a fact to which the surgeons pay far too little attention. In addition, the supravaginal amputation is a simpler and safer operation for the patient than total extirpation.

In the literature, one of the reasons often given for performing total extirpation in young women is the opinion that if a stump remains, a colium carcinoma can occur. This fear seems to me to be greatly exaggerated. I understand, indeed, that in older women this viewpoint can be considered. I do not understand, however, why in young women, for prophylactic reasons only, menstruation should be disturbed as well as the configuration of the vagina. It would not occur to any surgeon to extirpate the mamma in a woman who suffers from a fibroma of the mamma, because later on she might develop a carcinoma.

In my former work in Germany I believed in the conservative point of view regarding the operation on myoma but during my practice in Palestine I have gone still further, owing to the impressions which I have gained here. The desire for a child is so strong among the women of Palestine the preservation of the uterus plays such an important rôle, that the women prefer to undergo the greater danger of the conservative myomectomy if there is the slightest possibility of preserving conception. If in my former practice I told the women that after myomectomy I should endeavor to preserve menstruation they were for the most part satisfied. But in this country the women agree to this solution only if they have already had several children. This attitude is due particularly to the natural feeling toward children perhaps, however, to the fact that a childless marriage of 10 years' duration is legal ground for divorce. Under this impression, I have adopted a more conservative method of operation. I have seen that even in the presence of monstrous tumors, even if the uterus is permeated by tumors or if the tumors are situated antecervically or retrocervically intraligamentarily or submucously, the conservative operation can be used. Nor degenerative changes of the myoma contra indicate the use of the conservative method. While the conservative method is a well known procedure it is used only in exceptional cases.

In this paper I shall discuss my experiences since I have been using the conservative operative method, although in this country the number of difficult cases is very large.

In Jerusalem I have performed, up to the present time, 82 myoma operations, 40 of which were conservative, or 48.8 per cent.¹ The conservative myoma operation, of course, is justified only in women of a sexually mature age, i.e., up to an age of about 40 years. In this age group I have operated upon 67 women, and of this number conservative operation has been performed in 40 cases, that is in 59.7 per cent. Thus I have succeeded in preserving the uterus and both of the ovaries, or at least one, in more than half of the cases, so that the women not only menstruated but, in addition, possessed the possibility of conception. The percentage (59.7) includes the operations during my first year here as well, when I had not begun to use the conservative operative method so freely as I have done since. I have gradually increased the indications for this operation. Conservative myomectomy should not be performed if the woman is in the middle or at the end of the third decade and has already had children. In such cases it is sufficient to maintain menstruation. Of 67 women of a sexually mature age in 10 cases it was unnecessary to do the conservative operation as they had already had children. Therefore, the conservative operation was indicated in 57 cases and of this number 40 patients were operated on by the conservative method, that is in 70.2 per cent. Of my last 10 cases, 9 were operated upon by the conservative method.

The technique of the conservative operation is, no doubt, much more difficult than that of the supravaginal amputation or total extirpation. All these operations require typical methods, but conservative myomectomy is atypical, once the abdominal cavity is opened, a plan must be made according to the case. It is not sufficient to remove the myomas but in addition it is important to spare the musculature as far as possible in order to preserve a uterus capable of its function in pregnancy and parturition. If the uterus, following the operation, is a slack, weak organ it is, indeed, capable of menstruation but incapable of carrying the child and functioning in parturition. In such cases the high supravaginal amputation is the better way. The important points in the conservative operation are the following: (1) Every myoma must be enucleated. (2) The orifices of both tubes or, at least, of one of them must be spared. (3) The uterus must be recon-

¹At the meantime 8 more patients have been operated upon according to this method, so that there is now a total of 48 cases.

structured in such a manner as to preserve as much of the muscular tissue as possible. In order to test the last point I inject during or at the end of the operation one ampoule of posterior pituitary extract (pitocin) into the reconstructed uterus. The reaction to this injection becomes apparent by the contraction and rigidity of the uterus and thus according to the degree of contraction, the presence or absence of sufficient uterine musculature is demonstrated.

If the myoma is situated antecervically the bladder must be dissected off for a great extent, in case it is situated retrocervically and adheres to the rectum the latter must be sharply dissected away. If its site is within the ligament, the ureter must be dissected off. If the omentum or the small intestine adhere to the tumor they must be separated. I have learned from the literature that there are surgeons who after having ligated the uterine artery on one side decide to perform amputation of the uterus fearing a deficient circulation in the uterus with consequent nutritional disturbances. This view is faulty. As a matter of fact it is possible to ligate the uterine artery on one side without any disturbance occurring. Conservative myomectomy no doubt gives occasion for infection in a much higher degree than the radical operation because of the large wound cavities. Extreme attention must be paid therefore to asepsis during the operation.

I use the transverse abdominal incision at the level of the border of the pubic hair or somewhat higher so that later the incision is scarcely noticeable. This incision has the advantage that no postoperative hernias occur and the patient is not obliged to wear any kind of support whatsoever. In addition the low transverse incision is much better cosmetically than the median incision. The size of the tumor is not a contra indication to this type of incision. Even tumors which reach up to the costal arch can be removed through a transverse abdominal incision.

The use of a continuous intravenous drip of normal saline or a 5 per cent glucose solution has proved to be very practical if given before the operation takes place. This step is most effective in avoiding or combating postoperative shock and peripheral circulatory disturbances.

In the group of conservative operations I found degenerated tumors in 9 cases. Frequently there were different sorts of degeneration in the same case namely hyaline degeneration cystic softening (twice) beefy color hemorrhages into the myoma (twice) thrombosis and beginning necrosis of the myoma (7 times). Formerly I believed that such patients should not and could

not be operated upon conservatively. Experience, however has taught me that myomas with hyaline degeneration, with cystic softening tumors with hemorrhages and even with beginning necrosis, can be removed with conservative measures. The question becomes difficult to decide when there is a thrombosis in the myoma. Each case must be judged separately. Every nodule of the myoma must be inspected by transverse section during operation in order to avoid the danger of overlooking the presence of malignant degeneration. Every suspicious portion must be examined by the pathologist during operation both macroscopically and microscopically. This examination can generally be performed in a few minutes. The bed of the myoma must be very carefully sutured in three layers to eliminate wound cavities. At the end of the operation the uterus must be absolutely dry.

The course after a conservative operation frequently is not so smooth as that after a supra vaginal amputation. During the first 2 days after operation the temperature is usually above 38 degrees C then it usually becomes lower and remains subfebrile for a few days. I keep the patients in bed for 2 to 3 weeks after conservative operations.

All our results have been good except for one fatality. Forty six hours after operation the pulse was normal and the abdomen soft. In the evening at 9 o'clock she spoke to the nurse and 20 minutes later she was found dead in bed. Autopsy revealed a pulmonary embolism.

CASE REPORTS

Since it is impossible to report all the cases in detail I shall give the operative records of only a few cases in order to demonstrate the value of the conservative operative method.

CASE 1. A aged 30 years had been married for 6 months. Menstruation had been regular and had lasted 7 days with marked blood loss. The patient suffered during her menses from severe pain in the back and abdomen.

Operation was performed May 1, 1936 with chloroethyl ether narcosis. The transverse abdominal incision was used. The tumor extended a hand's breadth above the umbilicus corresponded in size to an 8 month pregnancy it was so wide that it filled the whole abdominal cavity. So many tumors were present that the uterus itself could not be recognized. It was only with difficulty that we succeeded in elevating the tumor outside the abdominal wall. We then saw that the tubes were so adherent to the fundus of the tumor that at first glance the conservative operation appeared to be impossible. However since the preservation of the uterus was of extreme importance in this patient we tried the conservative method realizing however that at the end of operation amputation could still be performed. The uterus was covered with subserous

tumors. On the fundus there was one tumor the size of a child's head and a second the size of a fist. On the anterior wall there were 12 tumors varying in size from that of a cherry to an orange. On the posterior wall there were 8 tumors laterally both on the right and left there were several tumors varying in size from that of a cherry to a plum. After the tumors of the fundus had been enucleated we gained access to the uterus itself. In this case we first divided the uterus sagittally in order to ascertain whether there were tumors in the muscular wall, whether there were submucous tumors in the uterine cavity and whether after removal of the tumors sufficient muscular tissue remained to permit us to reconstruct a uterus capable of functioning. The circle of tumors surrounding the sagittal section on the anterior and posterior wall was excised together with a piece of musculature. A small tumor of mandarin size situated directly at the tubal orifice was divided and very carefully shelled out of its bed. The tube could be easily shifted, so that the junction of the orifice with the uterine cavity was well preserved. At the same time from the sagittal section some intramural nodules were removed. In the remaining portions of the uterus intramural nodules could not be observed macroscopically. On the posterior wall a tumor protruded into the uterine cavity so that we had to open the cavity through an incision 15 centimeters in diameter. The cavity was then closed with several sutures. Removal of the lateral tumors was technically difficult. After the broad ligament was divided the tumors could be excised without, however, the ureter appearing. On transverse section two of the tumors showed degenerative changes namely hemorrhages and softening. The histological examination performed during operation excluded malignant changes. The beds of the myomas were sutured in three layers so that no gaps occurred in the tissues. After injection of 1 cubic centimeter pitocin the uterus contracted excellently and was the size of a normal uterus. Both tubes were patent. The orifices of the fallopian tubes had certainly not been injured. Finally the uterus was wrapped around with omentum. The patient thus kept her uterus and remained capable of conception. A total of thirty tumors had been removed. The follow up examination several months later revealed that menstruation was normal in every respect. The uterus had a normal configuration and sounding showed a length of 6.5 centimeters.

CASE 2. H. aged 28 years married 10 weeks. The menstruation had been regular and had lasted 3 to 4 days on the second day the loss of blood had been remarkable. For the past 2 years particularly the patient had observed that the circumference of her abdomen had increased considerably. She suffered from constipation.

The uterus was pushed to the right by an enormous tumor filling the entire abdomen. The upper edge of the tumor was two finger breadths beneath the costal arch and the tumor filled the left parametrium and Douglas pouch.

Operation was performed on June 16 1936, with chloroform-ether narcosis and through a transverse abdominal incision. After the peritoneum had been opened an enormous tumor reaching almost to the costal arch appeared. At first it could not be determined whether this mass consisted of a cyst a pregnancy or a myoma. Examination of the tumor revealed that it was a very large softened myoma. On the left the tumor adhered to the cervix and extended to the wall of the pelvis between the layers of the broad ligament. The uterus itself was covered with five subserous tumors varying in size from a cherry to a mandarin. Difficulty in removing the left sided tumor was encountered in the lateral areas where the tumor reached the

ureter and the uterine artery. This section was loosened at first by separation of the broad ligament dissecting off the ureter and freeing the tumor laterally from the large blood vessels. The left uterine artery was ligated. After one side of the tumor had been freed, the retrocervical portion was dissected away. Now the uterus with its immense tumor and small subserous myoma was freely movable. We did not meet with any technical difficulty in extirpation and enucleation of the other tumors. The uterus was precisely sutured in three layers and the result was a normally shaped uterus. Both tubes were patent and we were sure that they communicated with the uterine cavity. The ovaries were normal. Finally the uterus was wrapped around with omentum. Thus the patient had preserved a uterus capable of conception.

CASE 3. F. aged 36 years. Menstruation was regular and lasted 8 days. The loss of blood was considerable. During the latter years the patient constantly suffered from pain in the abdomen so that she was severely incapacitated in her work. She had been married for 9 years and had been anxiously longing for a child. This was the patient mentioned above who afterward died from a pulmonary embolism. The tumor extended a hand's breadth above the umbilicus corresponding in its size to a pregnancy of the seventh or eighth month. It filled the whole hypogastric region and Douglas pouch so as to push the uterus forward against the symphysis.

Operation was done May 5 1936 with transverse abdominal incision. After having opened the abdominal cavity we saw a monstrous tumor consisting of a large number of single nodules. One tumor the size of a man's head was situated retrocervically and filled Douglas' pouch like a mold. The uterus which was pushed forward showed at the fundus and on the anterior wall a circle of smaller myomas varying in size from a cherry to a plum. Furthermore there was a tumor the size of a child's head in the intraligamentary region on the right. The tumor was so firmly fixed by means of this last tumor and by the tumor in Douglas' pouch, that it could not be moved in any way. In order to elevate the tumor from the pelvis we had at first to excise the intraligamentary nodule on the right. In order to divide the latter the broad ligament on the right was divided. The intraligamentary tumor could now be grasped by forceps. After having dissected off the ureter the tumor was divided and was shelled out without difficulty. We were then able to reach the tumor in Douglas' pouch which was divided sagittally and removed in two parts. The posterior wall of this tumor was adherent to the rectum over a broad area of about 10 centimeters in diameter. The rectum had to be dissected away from the tumor with small forceps and scissors. After the tumor in Douglas' pouch had been removed there was no further difficulty in the operation. There were more than 20 smaller nodules which were enucleated and sutured one by one. Since the tumors lay close together near the midline some of them were closed, in three layers by means of the same suture. At the fundus three tumors of mandarin size were enucleated. We had to remove a total of 30 tumors. On the first and second day after operation the condition of the patient was exceedingly good. The abdomen was soft, the pulse good. Flatus had escaped and the stools were discharged. Spontaneous urination was possible. Forty six hours after operation sudden extus occurred because of pulmonary embolism.

CASE 4. The patient was 35 years old. Menstruation used to last for many days and was accompanied by a considerable loss of blood. She had been married for 2 years. She had had one abortion and was anxiously longing for a child. The transverse abdominal incision was used

TABLE I — PREGNANCY AFTER CONSERVATIVE MYOMECTOMY

Age	Number of years married	Diagnosis before	Abortions before
R 30	6	None	None
B 28	5	None	None
K 30	6	None	None
S 30	11	None	1
C 32	11	None	1
Sch 30	6	None	3
W 32	5	None	1 premature delivery 3 abortions

At first the appearance of the uterus seemed normal showing only some small subserous nodules on the posterior wall. The main tumor could be found only by palpation. It filled the depth of the pelvis so that the cervix itself was not palpable. It was therefore a myoma of the cervical portion.

After the bladder was dissected away from the tumor the latter was drawn forward with forceps, divided sagittally and then loosened from the cervix. On this occasion we saw that the tumor originated exclusively from the anterior wall of the cervix. The left uterine artery had to be ligated. The large wound bed was sutured in two layers. This case demonstrates that in a large antecervical myoma the conservative operative method can be used.

TUBAL FUNCTION

The conservative operative method attains its purpose only if the capability of conception can be restored. This is not possible in every case and if this becomes apparent during the operation there is no further purpose in proceeding conservatively. In the majority of cases at least one of the ostia of the fallopian tubes can be preserved. If one has to enucleate a tumor near the tube one should take special care not to open the lumen. I divide the myoma sagittally and dissect out every part separately from its bed. In this manner we are most likely to preserve the tubes.

The preservation of the tubes therefore is the most important factor during the operation. Only by a subsequent hysterosalpingography can we see whether the operation has been successful in regard to this point. I have had the opportunity of examining only 4 cases subsequent to operation. In 3 of them the tubes were patent on both sides or at least on one side. In one case the tubes could not be depicted. This event however does not prove that the passage of the tubes is not free. Every one who is experienced in salpingography knows that an impeded passage is not proved if

the tube cannot be depicted since the entrance of the Ipiodol into the tube can be prevented by spasms as well. We were particularly careful with the roentgenological proceeding after conservative operation in order to avoid too great a strain on the uterine musculature. In many of our cases the follow up examination was not necessary since the situation of the tumors excluded any possibility of injury to the tubes. In addition as we shall see later in some of the cases pregnancy occurred whereby the intactness of the tubes was best proved. The pregnancies occurred even before we had decided to perform salpingography.

PREGNANCY AFTER THE CONSERVATIVE OPERATION

Up to the present 7 women have become pregnant after the conservative operation. Pregnancy as well as parturition and puerperium have been normal. All these women had been married for several years and were childless. There is no doubt that it was only by operation that the sterility or the habitual abortion had been corrected (Table I).

Table I shows that pregnancy after conservative myomectomy occurred in young women 28 to 32 years of age who had been married from 2 to 11 years without having had children. In 3 of the women there had never been a pregnancy. 4 of the women had suffered from one to three abortions. Every gynecologist knows that the myoma in itself does not prevent conception and that even in monstrous tumors pregnancy can take place and that the fetus can be carried to full term. There are however cases in which the myoma certainly prevents conception or in case of conception brings about abortion. There is no doubt that in our women who had been married from 5 to 6 years without children the sterility was due to the presence of the myoma since immediately after coitus had been permitted after operation pregnancy occurred.

As these cases are of importance I shall describe them briefly.

CASE 1. R. aged 30 years married for 6 years without children. There were no abortions. The patient suffered from diabetes. Operation was performed in May 1935 with transverse abdominal incision. There were extensive adhesions of the omentum to the tumor and the rectum which had to be freed from the tumor mass. A myoma the size of a child's head situated at the fundus was excised. Ten subserous myomas varying in size from a bean to an olive were enucleated. From the left ovary a follicular cyst was excised, a piece of the ovary was resected and the ovary was reconstructed. Nine months after the operation

I then became pregnant so that there was a normal foetus.

the patient became pregnant. The diabetes did not de-
teriorate during pregnancy. She was treated with insulin.
Parturition took place at full term (July 1936) the child,
however, died some days later (adrenal hemorrhage). In
January 1937 she conceived again. Pregnancy and par-
turbation were normal and the child was healthy.

CASE 2. B. aged 28 years married for 3 years without
having had children. Operation was performed in June
1935 through a transverse abdominal incision. A left
sided intraligamentary myoma the size of a child's head
and some small subserous ones were found. In addition
there was a left sided ovarian cyst the size of a fist. The
ligamentum latum having been divided the intraligamen-
tary myoma was dissected away and removed from the
lateral wall of the uterus. The fairly profuse bleeding was
checked by knotted sutures the smaller myomas were
enucleated in the typical way. The ovarian cyst was shel-
led out the rest of the ovary reconstructed. At the end of
operation the patient had a uterus of normal configuration.
Subsequent to the operation menstruation was normal.
Eight months after the operation the menses failed to ap-
pear. The pregnancy test was positive. On November 3
1937 there was a normal spontaneous delivery and a
normal puerperium.

CASE 3. K. aged 30 years married for 6 years without
children. There were no abortions. Operation was per-
formed in February 1936 through the transverse ab-
dominal incision. To begin with it seemed hopeless to
operate upon this patient conservatively since the uterus
showed a large tumor on the posterior wall which appeared
to be inseparable from the musculature. In some places
the tumor was softened.

Since it was important to the patient that the uterus be
preserved we tried the conservative operation. The
tumor was divided sagittally and proved to be extensively
cystic and softened in its interior. The tumor reached the
uterine cavity. After the tumor had been loosened there
remained a large wound area on the posterior wall of the
uterus and in addition the cavity was opened for a con-
siderable extent. The cavity was now sutured then the
large wound bed was closed in 3 layers. In addition some
smaller subserous myomas were enucleated. In this case it
was very dubious whether the tubes had remained patent.
On the left this certainly was not so on the right there was
a possibility. Eight months after the operation the patient
became pregnant. This case indeed represents the great
possibilities of conservative treatment since the cavity
was opened wide the entire posterior wall of the uterus was
one large wound bed the tubes were displaced and it was
rather doubtful whether after the reconstruction of the
uterus the tubes joined the cavity. The occurrence of
pregnancy proved that the function of the uterus and the
tubes had been preserved. Pregnancy as well as parturition
were normal and so was the delivery of the placenta.

CASE 4. S. aged 30 years married for 11 years without
having had children. She had had one abortion. In 1935
salpingography was performed and showed a large uterine
cavity. In the beginning the tubes could not be visualized.
Only after the use of more powerful pressure they proved
to be patent. The operation was performed in April
1936 through a transverse abdominal incision. There were
two fist sized tumors on the anterior wall the lower of
which had developed antecervically beneath the bladder.
The peritoneum of the bladder therefore had to be dis-
sected away for a large extent. The removal of a third
tumor from the lateral wall was not so simple technically.
We did succeed however and saw in the transverse section
that the center was softened and showed a strange yellow
ish brown color. The histological examination carried out

during the operation proved that we were dealing with a
myoma with central necrosis. In spite of this finding the
conservative operation was continued. During the enu-
cleation of the second tumor the uterine cavity had to be
opened in an area 2 centimeters in diameter. The uterine
cavity was carefully closed with knotted sutures and then
the large myoma bed was closed in three layers. On the
posterior wall a myoma of cherry size also had to be enu-
cleated. The round ligaments were fixed to the anterior
wall of the uterus so that the uterus was anteverted and
the areas of suturing were covered. This case demonstrates
that even necrosis of the myoma is no reason for abstaining
from the conservative operation. The fact that the patient
became pregnant one year after operation demonstrated
that the uterus was normal in function. Parturition de-
livery of the placenta and puerperium were normal.

CASE 5. G. aged 32 years, had been married for 11
years without having had children. She had had one abor-
tion. Operation was performed in January, 1936 with
transverse abdominal incision. We found a left sided
intraligamentary tumor the size of a child's head tightly
adhering to the edge of the uterus. The parametrium had
to be broadly divided and the tumor cut out. The removal
from the lateral wall of the uterus was difficult. However
hemorrhage from the left uterine blood vessels occurred
which was controlled by ligating the vessels. In the uterus
itself there were twelve smaller myomas which were situ-
ated partly intramurally partly subserously. They were
enucleated in the typical manner and the beds of the myo-
mas were sutured. There remained a well formed uterus
with patent tubes. Six months after the operation preg-
nancy occurred with subsequent normal birth.

CASE 6. Sch. aged 30 years had been married for 6
years without having had children. She had had three
spontaneous abortions. The operation was performed in
April 1936 with transverse abdominal incision. Several
small cherry sized subserous myomas were enucleated. In
May 1937 menstruation failed to appear. The pregnancy
test was positive and the course of pregnancy parturition
and puerperium was normal.

CASE 7. W. aged 32 years had been married for 5 years
without children. She had had three spontaneous abortions
in the third month and one premature delivery in the
seventh month. The operation was performed in October
1936 with transverse abdominal incision. We found a
myomatous uterus consisting of several nodular masses a
fist sized tumor on the anterior wall a plum sized sub-
serous tumor on the posterior wall both on the right and
on the left sides nodules the size of a cherry. On the right
the tumor reached a point near the tubal orifice the tumor,
however could be dissected out in such a manner that
injury to the tube was avoided. Seven months after the
operation the patient became pregnant parturition as well
as puerperium were normal.

No doubt, parturition is fraught with the dan-
ger of rupture of the uterus following the con-
servative myomectomy. I did not, however, en-
counter a rupture of the uterus following this
operation. The important points are first to se-
lect the right type of incision in order to spare
the musculature of the uterus to the utmost de-
gree and second to suture the myoma beds per-
fectly. The 7 cases described all had normal de-
liveries, and the delivery of the placenta was
normal in spite of the fact that in some of the
cases the uterine cavity had been opened. In any

case we must take care that the women who have had a conservative myoma operation should be confined in the hospital where at any moment an operative delivery can be performed.

The objection which can be made to the conservative operation is that we do not radically remove the disease, that a new myoma may develop from a remaining focus. Theoretically this is undoubtedly correct. Practically, however, recurrence proved to be a rare event. Among the patients whom I operated upon in Palestine I saw only 2 cases of recurrence.

There are apparently only a few hospitals where the conservative operation is done as a matter of principle. Such an experienced surgeon as Bonney, who uses the conservative operative method chiefly, reports from his immense material of many years 2.3 per cent of recurrences. These excellent results can be obtained only by radically operating, i.e. by removing every perceivable and palpable myoma nodule. He who fears from technical reasons the removal of nodules from a dangerous site has not mastered the technique of the conservative operation. The women whom I have treated here readily took upon themselves the risk of a relapse of the uterus thereby to preserve the possibility of conception. After operation they felt that they were real

women. Relapse does not usually occur until years have elapsed, perhaps not before the woman is at an age when irradiation is the treatment of choice.

SUMMARY

1. Conservative myomectomy has been used on principle. Of 67 women in a sexually mature age 40 were operated upon conservatively (59.7 per cent). Of the last 10 cases 9 were operated upon conservatively.

2. The size, the number, the site or even benign degenerative changes in the myoma do not contra-indicate the use of the conservative operative method.

3. After the conservative operation conception took place in 7 patients in which the pregnancy as well as the parturition and puerperium were normal.

BIBLIOGRAPHY

1. BONNEY, V. J. *Obst. & Gynec. Brit. Emp.* 1937 44 1
2. FRANK and GOLDBERGER. *J. Am. M. Ass.* 1926 87 1719
3. WESTMANN, A. *Arch. f. Gynaek.* 1934 156 350
4. ZONDER, B. *J. Physiol.* 1934 4 81
5. Idem. *J. Obst. & Gynec. Brit. Emp.* 1938 45 1
6. ZONDER, B. and ASCHHEIM, S. *Klin. Wochenschr.* 1928 28 1321

Madelung's Deformity and Associated Deformity AT ELBOW

CHARLES F THOMPSON, M D, F A C S, Indianapolis, Indiana

BERNARD KAI AJIAN, M D, Charleston, South Carolina

THF growth deformity at the distal end of the radius, to which the name of Madelung has been attached, is described with considerable anatomical variation. Four typical additional cases are recorded in this report. Two of these were observed and treated for a period of 4 years prior to the termination of growth in the bones of the forearm. The remaining two were more recently discovered, and are to be treated in the near future. A fifth case, which presents many of the characteristics of the deformity, is included for completeness. Three separate surgical procedures were necessitated in the treatment of one of these patients. Two of the others are of particular interest because of associated deformity in the proximal end of the radius, with changes in the elbow joint.

HISTORY AND ETIOLOGY

The term, Madelung's deformity, predominates, in foreign literature, as a favorite one describing this entity. In addition, one finds Dupuytren Madelung disease, Madelung Duplay, radius brevis, congenital dysmorphism of the wrist, radius curvus, and more recently inferior radiocubital chondrodysplasia. American and British authors have designated this deformity as idiopathic progressive curvature of the radius, a spontaneous forward dislocation of the wrist joint, carpus varus and spontaneous subluxation of the wrist. It is necessary to distinguish between Madelung's deformity and what is frequently referred to as Madelung's disease. The typical deformity is curvature of the distal half of the radius in a combined volar and ulnar direction, shortening of the forearm, prominence of the distal end of the ulna, and volar subluxation of the hand at the wrist.

The deformity has been recognized at all ages. The etiology has been ascribed to fractures specific disease involving the distal radial epiphysis, congenital dislocation, arthritis congenital and adolescent rickets, osteochondritis, osteofibroma, and traumatic separation of the epiphysis. Madelung's disease, however, must be limited to those in which the deformity occurs with pain in early

adolescence, appears without trauma or infection, involves the distal growth center of the radius and terminates with early closure of this epiphyseal growth line. It is well to recognize that this is the clinical entity which Madelung described in 1878, and that the typical deformity following the disease is simulated from various known causes at other ages.

Madelung recognized the disease as a disturbance in growth, which develops spontaneously, never before 13 years and rarely after 23 years of age. He attributed the deformity to the powerful action of the flexors of the forearm, and mentioned primary weakness of the bones, or disturbance in nutrition as predisposing factors. Redard, in 1892, first recorded the opinion that the deformity resulted from a growth disturbance in the distal radial epiphyseal cartilage. This one factor has held pre-eminence over the possibility of rickets, trauma, local inflammatory disease, and trophic disturbances as possible etiological factors. The condition occurs seven times as frequently in females as in males. Two-thirds of the cases have bilateral deformities. Stetten reports that one third of the cases have a definite hereditary factor. The symptoms of the disease almost always appear in early adolescence. These facts limit the true etiology of the entity to an almost unknown factor. Therefore, if we speak of it as a disease, we must accept it as one of unknown etiology.

Recent German writers (Beder and Heinemann and Cserey Pechany), nevertheless, have reported isolated cases of the deformity associated with delay in the onset of menstruation, and attribute its cause to disturbance in ovarian function. Our findings would not support this view. The occurrence of the deformity in males as has been reported (8) could not be accounted for by such a theory. There has been no consistent relationship between this single localized growth disturbance and other growth disorders and deformities having a similar age frequency.

PATHOLOGICAL MECHANISM

The actual growth disturbance, which precedes the appearance of the deformity and causes pain



Fig 1 Case 1 Deformity in right wrist as compared to left at age of 13 years and 3 months

in the wrist probably has its onset months and perhaps years before recognition of the deformity. There is a considerable variation in the degree of the deformity as described by Schnek in which the extreme is the Konsolen form with an intermediate form in comparison to the normal radius. This variation readily accounts for some cases in which the deformity is not recognized until adult life when only a meager history of pain in the wrist during adolescence can be elicited. Claiborne and Kautz have recently called attention to the fact that incomplete and latent deformities occur in addition to those manifested clinically by pain and impairment of motion in the wrist. The earliest recognized cases have shown partial closure of the distal epiphyseal growth line on the volar and ulnar portions. With continued growth in the remaining portions of the epiphyseal line the typical curvature of the distal part of the radius results. Retardation of growth rate must precede premature closure of the growth plate if one is to account for the curvature in the diaphysis. This is the basis for the theory of disproportionate growth for a period of months or years before the onset of pain. Pain occurs only when the deformity is sufficient to distort or distract the distal radio-ulnar articulation.

The normal slight volar and ulnar angulation of the distal articular surface of the radius is gradually increased. This continues as long as any portion of the epiphyseal growth line exists as such and the distal end of the radius is protracted away from the ulna carrying the carpus and hand with it. An inverted V shaped arrangement of the proximal row of carpals results. The lunate is at the tip of the wedge formed by the articular surfaces of the radius and ulna. Fre-

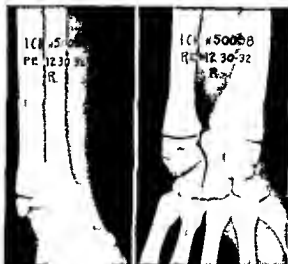


Fig 2 Case 1 Right wrist showing involvement of radius separation and dorsal displacement of ulna and wedging of carpals at 12 years and 10 months

quently there is a rather marked change in the shape of the affected carpals and often a longitudinal separation of the two rows following a line between the os lunatum and os triquetrum and between the os capitatum and os hamatum. Premature closure of the radial epiphyseal growth line occurs. The ulna continues to grow and projects dorsally and distally from the subluxated carpus and hand.

CLINICAL SYMPTOMS

Pain and limited motion of the carpus and distal radio-ulnar articulation are the early symptoms except in the milder degrees of the deformity in which only the distortion of the wrist is noted. The earlier the onset of pain the more severe is the deformity which follows. Any active use of the hand apparently aggravates the pain. Such a combination of symptoms is justifiably accounted for in the mind of the child or its parents by a strain or minor injury. The pain is usually constant in character. Only slight relief can be expected from the most efficient fixation. The hand deviates to the ulnar side. The prominent distal end of the ulna may be replaced to the level of the wrist by pressure but returns to its dorsal position when pressure is released. Viewed on a lateral plane the hand is subluxated toward the volar surface on the forearm.

TREATMENT

Pain is the most constant symptom necessitating therapy. Almost invariably authors mention



Fig 3 Case 1 Partial closure of the distal ulnar epiphysis has occurred 10 months after operative epiphyseal arrest. Age 14 years 2 months

the failure of protective appliances in its relief. The deformity at the termination of growth is readily corrected by osteotomy.

Phemister first advocated epiphyseal arrest at the distal end of the ulna to retard its growth. Burrows has combined resection of the juxta epiphyseal portion of the shaft of the ulna and excision of the ulnar epiphyseal disc with simultaneous linear osteotomy of the radius before termination of growth in this bone. Lewin has excised the distal end of the ulna, at a point corresponding to the length of the radius, to correct the inequality in the length of the two bones. Ovarian hormones have been administered with alleged good results (4), but the success of such treatment must obviously depend on the rapidity of development and degree of deformity in an individual case. Schnef has used corrective osteotomy of the radius alone, in cases in which the disproportion in the length of the bones was not a major factor in the deformity.

CASE 1. R. E. a schoolgirl 13 years of age was brought to the out patient orthopaedic clinic of the Indianapolis City Hospital on December 30, 1932. Her mother stated that the child had a painful deformity of the right wrist, which was first noticed 3 months previously. A sprain during play at school was mentioned as a possible cause. The girl denied any swelling or disability of the wrist at the insidious onset of the pain. This pain never throbbing in character had been constant and was aggravated by use of the hand in playing the piano and school work.

A study of her previous history did not disclose any record of prolonged illness or infectious disease. No bone or joint deformities were present in either parent or her one sister. Menstruation had not started and the second ary sexual characteristics were not yet in evidence.



Fig 4 Case 1 Four weeks after second operation—osteotomy of ulna. Note improvement in relationship of radius and ulna as compared with Figure 3. Age 15 years 4 months

There was ulnar deviation of the hand with a curvature of the radius the concavity of which was toward the volar and ulnar surfaces of the forearm. There was 2 centimeters shortening of the forearm and hand as compared with the left. The distal end of the ulna protruded dorsally from the wrist (Fig. 1).

No signs of inflammatory processes about the wrist were present and signs of systemic disease contributing to her complaint were not found. Roentgenograms made that day disclosed changes in the wrist consistent with a diagnosis of typical Madelung's deformity (Fig. 2). It was noted that the closure of the ulnar portion of the distal radial growth line was continuous with a distortion of bony

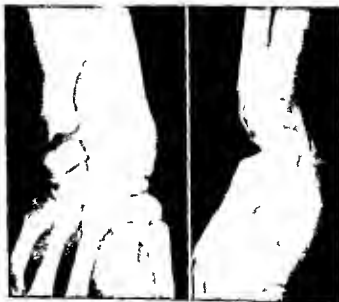


Fig 5 Case 1 End result of ulnar osteotomy. Ulnar epiphyseal line closed, radial partially open. Age 15 years 9 months

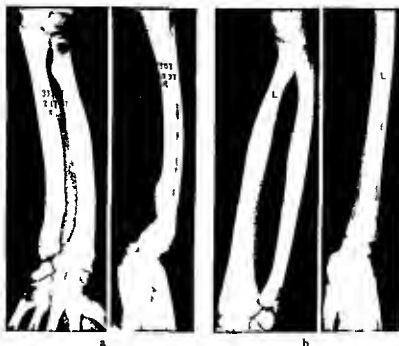


Fig 6 Case 1 a Deformity present at termination of growth and before ulnar corrective osteotomies Age 17 years b Left forearm and wrist for comparison with Figure 6a

trabeculae and contour which extended proximally for a distance equal to the width of the bone at that level.

A volar plaster splint was applied for fixation of the hand in a neutral position. At the end of 3 weeks this was removed and reapplied. At the end of 10 weeks of fixation March 16 1933 there had been no noticeable relief of pain. Roentgenograms were made of both wrists April 24 1933 for comparative purposes. The retardation in longitudinal growth of the right radius as compared with the left was recognized. At this time some relief from pain was noted after prolonged protection of the hand and forearm in a sling.

On June 1 1933 the patient was hospitalized. Routine laboratory examination failed to disclose any evidence of systemic disease or infection. On June 8 1933 under general anesthesia an epiphyseal arrest by excision of the distal ulnar epiphyseal growth line was performed. A volar plaster splint was again applied for fixation of the hand and wrist. Roentgenograms made June 13 1933 revealed a slight increase in the deformity. Fixation of the extremity was maintained for four weeks following the operation.

The patient was free from pain in the wrist for 8 to 10 months following this surgical procedure. She returned in March 1934 with recurrence of pain and an increase in the deformity. She reported that menstruation had started but at the age of 14 years; this delay was consistent with that of her mother and sister.

Roentgenograms made at this time (Fig 3) revealed a partial closure of the distal ulnar epiphyseal growth line and changes in the distal end of the radius. Protection for a period of 2 months was maintained with only slight relief of pain.

During the next year there was a recurrence of pain and an increase in the limitation of motion involving rotation of both the forearm and the wrist proper. On April 29

1935 under local anesthesia resection of 2 centimeters of the shaft of the ulna just proximal to the wrist joint was performed. Immediate relief from pain followed this procedure. The distal fragment of the osteotomized ulna dropped to the level of the radius and the radio-ulnar articulation was restored (Fig 4). Bony union occurred at the site of the osteotomy in 3 months. The subsequent appearance of the wrist is disclosed in roentgenogram taken January 12 1936 (Fig 5). The patient remained free from pain although roentgenograms made April 12 1936 1 year after the second operation revealed still greater increase in the deformity and closure of the remaining small portion of the distal epiphyseal growth line of the radius. The radio-ulnar articulation and the approximation of the carpals were fairly well restored by the ulnar shortening procedure. The patient was then 16 years of age.

On February 17 1937 at 17 years of age she reported complete freedom from pain since the surgical shortening of the ulna and desired correction of the remaining deformity. Roentgenograms made then (Fig 6a) disclosed cessation of growth of the radius and ulna with closure of the distal epiphyseal growth lines. The deformity at this time was of considerable degree as is shown in Figure 7. There was a 4.5 centimeters shortening of the right forearm and hand. At this time under general anesthesia incomplete linear osteotomies were performed at the maximum points of curvature of the radius and ulna. There was partial healing with satisfactory alignment by March 22 1937. Protection was applied to the arm for a period of 8 weeks. A good cosmetic result was obtained (Figs 8a and b). The end result as shown roentgenographically was satisfactory (Fig 9). The changes in angulation of the articular surfaces of the distal ends of the radius and ulna are shown diagrammatically in Figure 10.



Fig 7

Fig 8a

Fig 8b

Fig 7 Case 1 Gross deformity at termination of growth period and shortening in the right forearm

Fig 8 Case 1 a Illustrating the gross appearance and cosmetic results following the final osteotomies Note the lack of curvature in the forearm b Illustrating the difference in length between the two forearms and the reduction in curvature following the final osteotomies

From a functional standpoint the right forearm was markedly improved by the corrective osteotomies although there was a 20 per cent limitation in rotation of the right as compared with the left and the arc of motion at the wrist was restricted to 75 per cent of that on the left. Throughout the latter 2 years of the progress of her deformity this patient played the piano with sufficient skill to hold a place of honor in her school orchestra and has since followed the same vocation with a private orchestra.

CASE 2 H A schoolgirl 13 years of age was brought to the out patient orthopaedic department of the Riley Hospital Indianapolis on April 26 1933. Her mother stated that she had had pain in her right wrist associated with a slight deformity for 1½ months. The onset of the pain was insidious and was not associated with any known trauma. The pain had increased in severity since its onset. This symptom was never of sufficient severity however to warrant protection. No other joint had been painful and there were no systemic symptoms preceding the onset of her complaint. The mother corroborated the statement that the patient had suffered no unusual accident during the 2 years prior to the onset of her trouble. Prolonged use of the hand at school and light housework were definite aggravating factors.

A study of her previous history failed to reveal any evidence of serious illness other than childhood diseases. Her parents and one sister were free from any skeletal deformities and were of average height and weight. Menstruation started at 11½ years and the secondary sexual characteristics were normal.

Prominence of the distal end of the ulna and ulnar deviation of the right wrist were noted. There were no signs of swelling or inflammation in the wrist. Similar changes were noted in the opposite wrist but no complaint of pain in the left was made. Limited motion in the right wrist was consistent with the deformity. A moderate cubitus valgus was noted.

Roentgenograms of both wrists disclosed partial closure of the distal radial epiphyseal growth lines and other

changes conforming to those of Madelung's deformity (Fig 11a and b). The changes were more marked on the right. Epiphyseal arrest in the distal end of the right ulna was advised but surgical treatment was refused. Limitation of

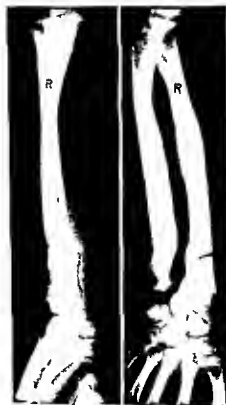


Fig 9 Case 1 Showing the roentgenographic end result of the corrective osteotomies 8 weeks after operation

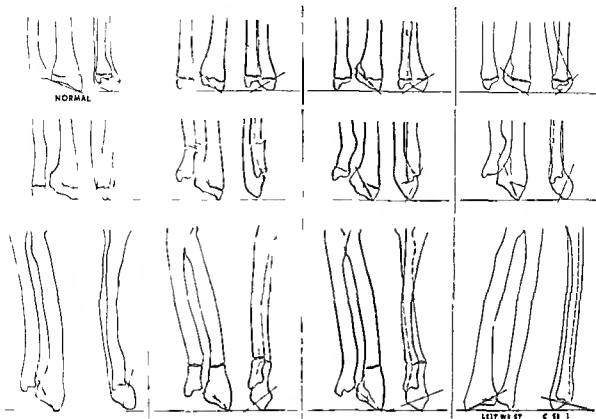


Fig 10 Case 1 Chart showing diagrammatically the changes in angulation of the distal articular surface of the radius at the stages in the handling of this patient previously illustrated.

the use of the forearm cast with the pain present was advised as an alternative.

Re-examination on November 5, 1933, revealed the history that the pain had subsided after a few months and had remained absent. A slight increase in the deformity was noted. There was definite anterolateral curvature in the left radius also.

It was not until March 30, 1937, that roentgenograms were again obtained on this patient who was then 17 years of age. The distal epiphyseal line had closed in both the radius and ulna with typical deformities of Madelung's type. Rotation of each forearm was limited to an arc 120 degrees. There was instability at each elbow in its lateral plane and a definite bony click upon abduction of the joint. Full length studies of the radius and ulna of both arms at this time revealed atrophy of the proximal end of the radius and distraction of the head of the radius from the elbow. Hypertrophy of the fused capitellum was noted. These changes are shown diagrammatically in Figure 12a and b. Cubitus valgus of 30 degrees and lateral instability of 5 degrees was present in each elbow.

CASE 3 C J a schoolgirl 14 years of age was brought to the out patient orthopedic clinic of the Koper Hospital Charleston on June 13, 1933. Her mother stated that the girl had had pain and a noticeable deformity of the left wrist for 3 months. She had suffered a somewhat severe fall at school with injury to her knee and possible injury to the wrist. The injury to the knee was immediately painful and

she was kept in bed for the following month. During this time she first noticed slight pain in the left wrist which gradually increased prior to admission. The pain was constant and increased with use of the hand in household tasks. The deformity gradually increased and was rather marked on admission.

A study of her previous history revealed childhood diseases a partial facial paralysis on the left side at 6 years of age and no serious illness since childhood. There was a definite history of exposure to a cold draft to account for the facial paralysis and there was only a slight residual paralysis in the left side of the mouth. Menstruation had started at 12 years and the secondary sexual characteristics were normal. There was no skeletal deformity in either parent and an older sister.

The deformity present was an ulnar deviation of the wrist and hand and some volar displacement with prominence of the distal ends of the radius and ulna dorsally. Roentgenograms made on that day revealed the changes in the radius and ulna characteristic of Madelung's deformity. A support to the forearm and protection of it was advised and carried out for approximately 3 months. There was no relief from pain and no improvement in the deformity. Surgery as then advised but was refused.

The patient was next seen on December 22, 1937, at which time roentgenograms (Fig 13a b and c) were made. Her only complaints then were of slight pain in the left wrist after long hours of work. As will be readily seen the



Fig 11 Case 2 a Anteroposterior view of both wrists showing changes typical of Madelung's deformity more marked on the right Age 13 years 2 months b Lateral view of both wrists at same age

right wrist was also involved but the patient stated that she had never had pain in it. The changes were typical of Madelung's deformity being much more marked on the left. There is a definite shortening—3 centimeters—of the left forearm as compared with the right.

The deformity present in the left forearm is a marked ulnar deviation and volar displacement of the wrist and hand. There is limitation in rotation of the forearm and extension and abduction of the wrist and hand. Corrective osteotomies of the radius and ulna are to be performed in the near future since the end of the growth period has been reached.

CASE 4 J. C. a graduate nurse 21 years of age presented herself at the x-ray department of the Roper Hospital Charleston on December 30 1937. She complained of painful deformities of both wrists present since adolescence. This patient stated that pain was first noticed in

the left wrist when she was 12 years of age. Shortly thereafter she noticed pain in the right wrist, though it was never as constant as that on the left. The deformities became noticeable when she was 13 years of age and gradually increased until she reached 18 years of age. Since that time there has been no apparent change in the appearance of either wrist. The pain was never very constant in either wrist but always more marked on the left and always aggravated by tiring work such as knitting. She never had sufficient discomfort to wear any kind of supportive device. During her years of nurses training in this hospital she was repeatedly advised to have surgical attention but always refused.

A study of her past history revealed the usual childhood diseases but no serious illness since early childhood. Menstruation started at 12 years of age and the secondary sexual characteristics appeared normally. There is no skeletal

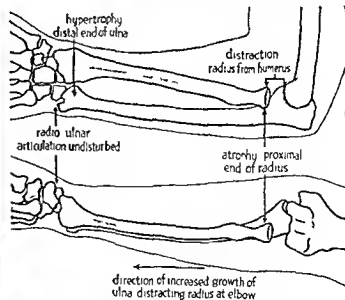


Fig 12 Case 2 a left Retouched roentgenogram to illustrate changes at elbow b c, atrophy and distraction of

head of radius and hypertrophy of capitulum b Diagrammatic representation of Figure 12a

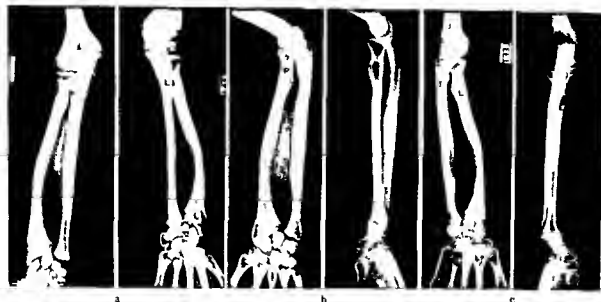


Fig 13. Case 3. a Both forearms in supination. Note the increase in deformity on the left with marked shortening of the radius and the slight deformity on the right. Age 18 years. b Right forearm in lateral and pronated

positions. Compare with Figure 13a and c. Age 18 years. c Left forearm in lateral and pronated positions. Compare with Figure 13a and b. Age 18 years.

etal deformity in either of her parents. Her one sister older has a slight prominence of the distal end of the left ulna but no other signs of deformity. Unfortunately this sister would not consent to have roentgenograms made of her wrists.

This patient has a marked curvature of each radius with the concavities toward the volar and ulnar surfaces, an ulnar deviation of each wrist and hand, a volar displacement of the wrists and a marked prominence of the distal end of each ulna. There is a definite loss or limitation in rotation in each forearm. This is more pronounced on the left where there is at least 60 per cent reduction in ability to supinate the forearm and hand. There is limitation in abduction and extension of the wrist and hand somewhat more evident on the left.

The full length roentgenograms of each forearm (Fig 14) reveal the changes characteristic of Madelung's deformity. They are perhaps a little more pronounced on the left. On the right however there is definite distraction of the proximal end of the radius from the elbow and some overgrowth of the capitellum as noted in Case 2. The exostoses so frequently reported in the literature as occurring on the ulnar side of the lower or distal end of the radius are clearly demonstrated in this patient. The distal epiphyseal growth lines have become completely closed and become obliterated as one would expect.

This patient cannot recall any trauma which might account for the beginning of these deformities. She has been reluctant about having any attention called to her wrists but has finally consented to have osteotomies in the near future for the correction of the deformities. The end results on this patient and Case 3 will be reported at a later date.

CASE 5. A. L., an office worker, 26 years of age presented herself at the x-ray department of the Methodist Hospital Indianapolis on August 20, 1937. She stated that she had had slight pain and deformity of both wrists for many years. The deformities first became noticeable

when she was 11 years of age. There was no definite history of previous trauma to either wrist or forearm. The deformity in the left wrist increased slightly in the following year and became painful after exertion. Her physician recommended the wearing of braces for each wrist which she did for 2 years. These did not correct the deformity or relieve the occasional pain.

A study of her previous history revealed no evidence of serious illness since early childhood. Menstruation began at 13 years of age and the secondary sexual characteristics developed normally. There was no skeletal defect in her father. Her mother had always had rather large wrists which became painful at times after arduous labor. No other relatives were known to have deformities of this character.

This patient has a definite prominence of the distal end of the radius and ulna, more noticeable on the left, a slight ulnar deviation of the wrist and hand, also more marked on the left, a slight volar displacement of the wrist and hand and an increase in the curvature of the lower one half of each radius. There was only slight limitation in rotation of the forearms but definite limitation in extension of the wrists and hands and some limitation in abduction. At that time she had pain only after excessive use of the hand as in knitting. There was not sufficient deformity or disability present to consider operative interference.

Roentgenograms of both forearms and wrists (Fig 15) reveal many of the characteristic changes of Madelung's deformity. They are more marked on the left. There is an increase in curvature of the distal half of the radius with concavity toward the ulnar and volar surfaces. There are distinct increases in the angulations of the distal articular surface of each radius. There is some dorsal displacement of the distal end of each ulna and a slight volar displacement of each wrist. The changes are not as extreme as those seen in other patients reported here but probably represent an incomplete or frustrated form of this type of deformity.



Fig 14. Case 4. Both forearms in pronation showing typical Madelung's deformities bilaterally. Exostoses on the radius are clearly shown in this case. Age 21 years.

The first three patients presented themselves at approximately the same age and within a few months after the onset of clinical signs indicating Madelung's deformity, but showed striking variations in the development of their deformities. No demonstrable cause for the partial arrest of growth and premature closure of the distal radial epiphyseal growth line was found in either of the first two. The history of trauma, in the third case, was indefinite as far as the wrist was concerned, and certainly of debatable significance in the light of later discovery of involvement of the opposite wrist. The last two patients presented themselves at later ages, when the deformities present had become stationary.

No other bony anomalies were found in any of these patients, and thorough search, including roentgenographic examination, was made in each case. In only one case was there any familial history that was even suggestive of hereditary factors. All patients observed with the deformity were females. All had normal sexual development during adolescence, with the onset of menstruation being slightly delayed in only one case, in which this was apparently familial. One could not say that there was any evidence of deficiency in ovarian function in any of these patients.

On one patient, Case 1, three separate surgical procedures were done. Epiphyseal arrest, and later resection of a portion of the diaphysis of the ulna near the wrist, were successful in obtaining



Fig 15. Case 5. Left forearm in pronation and a lateral position. The changes are quite typical of Madelung's deformity.

a pain free joint. It must be admitted that the second was the more effectual of the two procedures, but conservatism prompted the less radical first operation. The final osteotomies were done for cosmetic purposes, and contributed materially to increase the function of the deformed wrist.

In Cases 2 and 4, there is demonstrated a previously undescribed growth defect in the radius, associated with Madelung's deformity. This is an atrophy of the proximal end of the radius, and distraction of it from the elbow, with hypertrophy of the capitulum, but no functional impairment of the joint. This phenomenon readily accounts for the comparative freedom from pain at the wrist in spite of considerable deformity there. The cubitus valgus and the hypertrophy of the capitulum present in these cases, are no doubt physiological compensation for the deficient length of the radius.

It is logical to assume that, in these patients, distortion of the distal radio ulnar joint did not occur during the progressive growth of the deformity, because fairly normal relationships were maintained by the wrist ligaments and distraction of the radius from the elbow followed the continued growth of the ulna at the wrist. No pain apparently accompanied the changes at the elbow. The shortening of the radius was compensated for by its being drawn away from the elbow, rather than remaining as a fixed element there and allowing projection of the ulna at the wrist.

SUMMARY AND CONCLUSIONS

Madelung's disease is an entity of unknown etiology, involving the distal end of the radius

There is a primary disturbance in the bone in this region followed by pain and the development of a deformity—Madelung's deformity—in the adolescent years. The specific portion of the radius involved is the region of the distal epiphyseal growth line where there is growth disturbance and premature closure with resultant production of deformity and pain. The pain is the result of distortion by the deformity of the distal radio-ulnar and carpal articulations.

The severity of the pain is directly proportional to the degree of the deformity except in those cases in which the element of distraction of the head of the radius from the elbow enters as illustrated in 2 cases here reported.

Certain cases do not present all of the signs of the disease and deformity but undoubtedly represent an incomplete form rather than a pseudo Madelung's deformity. In some cases the deformity may be simulated following injury or known disease but these cannot be classified as true Madelung's disease.

Resection of a portion of the diaphysis of the ulna near the wrist joint is the most effective means of relieving the pain as it corrects the distortion of the joints. Corrective osteotomies at the points of greatest curvature after growth is completed in both bones, will reduce the deformity and increase the function of wrist and hand.

The authors wish to thank the departments of roentgenology and illustrations of the Indiana University Hospitals, the department of roentgenology of the Indianapolis City Hospital, the departments of roentgenology and illustrations of the Methodist Hospital Indianapolis and the department of roentgenology of the Roper Hospital Charleston for assistance in the preparation of illustrative material used in this article.

REFERENCES

1. BEDER, W. L. and HEINISMAN, J. K. Importance of endocrine (ovarian) dysfunction in the gene is of Madelung deformity 2 cases. *Fortschr. u. Geb. d. Röntgenstrahlen* 1935 57 595-601.
2. BURROWS, H. JACKSON. *Proc. Roy. Soc. Med.* 1937 30 565-572.
3. CLAIBORNE, E. M. and KAUTZ, F. G. Madelung's deformity of the wrist. *Radiology* 1936 27 594-599.
4. CSEREY, P. ECHANY, A. Possible ovarian origin and ovarian hormone treatment of Madelung's deformity 2 cases. *Zentralbl. f. Chir.* 1930 57 774-777.
5. LEWIN, Quoted by Moore, B. H. Madelung's deformity. *J. Bone & Joint Surg.* 1924 6 568-574.
6. PHENISTER, D. B. Operative arrestment of longitudinal growth of bones in the treatment of deformities. *J. Bone & Joint Surg.* 1933 15 1-15.
7. SCHNEA, F. Springy dorsal dislocation of ulna. Madelung's deformity. *Ztschr. f. orthop. Chir.* 1931 53 101-110.
8. STETTER, D. W. Idiopathic progressive curvature of the radius or so-called Madelung's deformity of the wrist (carpus varus and carpus valgus) with particular consideration of the unusual reversed or backward form of the lesion. *Surg. Gynec. & Obst.* 1909 8 4-31.

OPEN REDUCTION OF FRACTURES WITH SPECIAL BONE APPROXIMATOR

B DÁVILA, M D, Rio Piedras Puerto Rico

A CONTROVERSY exists among the advocates of open reduction in the treatment of fractures and those who insist that all fractures, with very few exceptions, should be treated by the closed method. This controversy is clearly brought out by quoting divergent viewpoints of outstanding surgeons.

Dr Lorenz Boehler, of the University of Vienna, says "The most unfortunate innovation in the treatment of recent fractures is the routine exposure and reduction by open operation, particularly if this practice is carried out by inexperienced persons without special indications, with defective appliances, and with the application of large metal foreign bodies. Thousands of human lives have been sacrificed by these procedures and many more have been crippled by them."

Dr W O Sherman, of Pittsburgh, in his recent fracture oration before the Clinical Congress of the American College of Surgeons in Chicago said "For the past 30 years severe criticism has been leveled at those who have used steel bone plates, screws, nails, etc. Many of the leading critics in personal interviews have admitted to me, that they never had any experience whatsoever with steel plates, screws, or nails in the treatment of acute fractures, and that their opinion was based entirely on the poor end results which they have seen in cases in which the operation was imperfectly or poorly done. Since the World War there has been a 'mass production' of bone and joint specialists many of whom lack general surgical training. A surgeon who requires three hours to do an operation that should be done in forty five minutes should not attempt it."

In my opinion both men are correct. In recent years the tendency of open reduction in the treatment of fractures has increased considerably. The open reduction of a fracture made by a competent surgeon who follows scrupulously the non contact technique of Lane, and practises a rigorous asepsis, in my opinion takes no more risk than when he operates on a chronic appendix. Poor results in the operative treatment of fractures are due to incompetency because of improper selection of cases, poor surgical technique, and asepsis. Operating treatment involves great danger if done when the soft tissues have not had sufficient time

to recuperate from the trauma caused by the fracture and transportation. Operating in the presence of edema, blebs, and excoriations of the skin is a mistake by which the life of the patient is jeopardized.

The majority of fractures can be treated by the closed method. However, in a good number of fractures the surgeon is unable to get a perfect reduction by the closed method. Examples are

- 1 Fractures involving joints in which the short fragment acts as a loose body, i.e., the upper end of the humerus and radius

- 2 Fractures with distractions, patella, olecranon etc

- 3 The intracapsular fracture of the neck of the femur in which the best results are being obtained by following the teachings of Smith Petersen as advocated by him, Moore, Cubbins, and others

- 4 Fractures with badly displaced fragments in which interposition of soft tissue takes place

- 5 Lastly, every surgeon will have to face the problem of the fracture coming to him between 2 weeks to several months or years after its occurrence

Every surgeon doing fracture work has had the experience of seeing a patient with a fracture of the femur with strong bony union in a poor position with an overlapping of one inch or more, or with a fracture of the lower third of the humerus mal united with marked angulation and stiff elbow joint, etc., with fractured tibia with 1 or 2 inches of shortness, etc.

For several years we have been employing the technique we are about to describe in operative treatment of acute fractures of the long bones.

- 1 *Time* As a rule we operate between the twelfth and fifteenth day after the occurrence of the fracture. During these first 2 weeks we try to do a closed reduction but if we fail to obtain the proper position of the fragments, we do not hesitate to operate. During those 2 weeks the patient is prepared for operation, and the soft parts have had a chance to rehabilitate themselves of the original trauma.

- 2 *The preparation* The day before the operation, the operative field is thoroughly cleansed with soap and water followed by alcohol, and is covered with a sterile towel.



Fig 1a Transverse fracture of right femur through middle third with strong bony union in poor position 3 weeks after accident

Fig 1b Transverse fracture of right femur of the lower third 25 days after accident with strong bony union in very poor position



Fig 3a Two months after operation Both bone approximator and wire removed with perfect results

Fig 3b Same case 1 month after operation with fragments in very good position and strong bony union Wire and approximator removed 6 weeks after operation

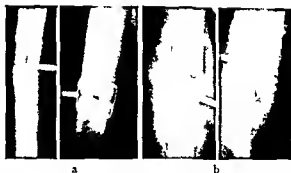


Fig 2a Same case 2 weeks after operation Note perfect position of fragments

Fig 2b Same case 2 weeks after operation showing fragments in good position

3 Technique of operation At the time of operation the field is prepared again with tincture of iodine followed by alcohol and finally painted with a mixture of both. The surgeon personally drapes the field. He wears two pairs of gloves and discards the outer pair when the patient has been draped and the towels affixed with clips to the edges of the wound. Under no circumstances should the fingers instruments or surgical material used in the operation touch the skin since this constitutes a potential source of contamination. The knife used to make the incision through the skin is discarded immediately and a new knife is used for the deeper structure.

The smallest possible incision is made and about one half inch of each fragment is exposed. Stripping the fragments of their periosteum or bringing the fragments out in the operative field should not

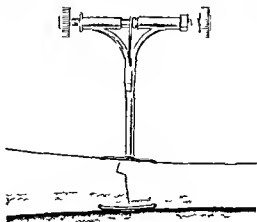


Fig 4 Drawing of bone with transverse fracture showing bone approximator with wire in place. Note how fragments are kept in perfect position

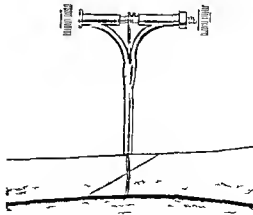


Fig 5 Drawing of bone with an oblique fracture showing wire wound around fragments. It is unnecessary to pass wire through the fragments.

be done. Reduction of the fracture is carried on by traction and manipulation.

A hand driven drill to which is affixed a fine Kirschner wire is used to drill a hole in each fragment, about $\frac{1}{2}$ inch from the site of the fracture. A steel wire (Babcock's No. 18 or No. 22) is passed through the hole drilled in one fragment, then across the site of the fracture, finally passing the wire through the other hole in the opposite direction. The two ends of wire emerging from the wound are passed through the cannula of the bone approximator which we use, the fragments are set in good position and the knob of the instrument is turned until enough pull is exerted by the wire to keep the fragments in perfect position (see Figs. 1 to 4, a and b).

In the oblique type of fracture it is not necessary to pass the wire through the fragments. In such cases the wire is wound around the fragments, a small groove is made in the bone (Fig. 5).

A clean operative field is of the utmost importance so that perfect hemostasis is carried out all throughout the operation. The wound is closed in layers with simple No. 1 catgut and the skin is closed in the usual manner.

4. Postoperative treatment. According to the type of fracture the postoperative handling may be done by application of cast, the use of Russell traction, Thomas splint with Pierson attachment, etc. The position of the fragments are checked by means of x ray, 24 hours, 2 weeks, and a month following operation. Once the fragments have been accurately reduced and immobilized, active movements are started on the second postoperative day, since this increases the circulation and stimulates the callus formation. If at the end of a month the x ray film shows that there is enough callus to keep the fragments in position, the instrument is pulled out and the steel wire is removed. If the x ray film shows that there is not sufficient callus, then another 2 weeks of waiting is necessary. Lately in cases of fracture of the lower limb we have made our cases crutch ambulatory by applying a cast which includes the bone approximator (see Fig. 6). Naturally this reduces considerably the time of hospitalization ordinarily required.

The bone approximator is easily removed, but for the removal of the steel wire, a strong pull is required. Sometimes the wire is left in place for



Fig. 6. Patient with transverse fracture of right femur. Crutch ambulatory, 1 week after operation. The approximator has been included in the cast.

several days after the bone approximator has been removed.

ADVANTAGES

1. Absolute reduction is maintained.
2. No foreign body is left in the bone since both wire and approximator are removed in between 4 to 8 weeks, thereby eliminating a secondary operation.
3. Since a very small portion of bone is exposed the incision required is smaller than for bone plating, thus the trauma to the tissue is less.
4. Ambulatory treatment is possible thus reducing hospitalization.

INTERSCAPULOTHORACIC AMPUTATION FOR MALIGNANT TUMORS OF THE SHOULDER REGION

DANIEL H. LEVINTHAL, M.D., F.A.C.S. and ABRAHAM GROSSMAN, M.D.
Chicago, Illinois

THE treatment of malignant tumors about the shoulder is one of the most serious problems in surgery. The standard operative procedure for such neoplasms is the interscapulothoracic amputation which consists in the removal *en bloc* of the forequarter consisting of the upper extremity, clavicle, scapula and all the muscles overlying the thoracic cage in this extensive area. The loss of limb itself is serious enough, but this amputation is so mutilating and severely shocking that the patient will not often submit to it and the surgeon will frequently hesitate to perform it even when the indications are definite.

Occasionally, such tumors are of a radio-sensitive nature such as the Ewing's sarcoma and may be successfully treated without radical surgery. More often they are quite radioresistant such as the osteogenic sarcoma or chondrosarcoma and will not respond to radiotherapy. All too frequently irradiation or local surgical excision of such lesions is attempted only to be followed by local recurrence and sometimes by pulmonary or other distant metastases by the time interscapulothoracic amputation is considered. In addition excessive irradiation of the shoulder region may lead sometimes to pulmonary fibrosis.

Recent observation of a case of chondrosarcoma which had been treated by local excision and irradiation with immediate recurrence excruciating pain and disability prompted the investigation of the entire subject of shoulder girdle amputation. The results of this study and case report are presented.

CASE REPORT

H. N., a 22 year old white male, presented himself for examination at the Tumor Clinic of the Michael Reese Hospital in January 1938. He complained of excruciating pain, swelling, limited motion and exquisite tenderness in the right shoulder region. He stated that he first noted a swelling in the right arm pit in May 1937. This rapidly grew larger, became painful and tender until 1 month later it had reached the size of a grapefruit and the function of the shoulder joint had become markedly impaired. The roentgenogram (Fig. 1) shows the appearance of this lesion.

From the Michael Reese Hospital, Department of Orthopedic Surgery and the Tumor Clinic.

In June 1937. At this time a local excision of the tumor was performed elsewhere. The histological diagnosis was fibrochondrosarcoma, grade 2. Intensive deep x-ray therapy and a superficial application of radium were administered after operation. Within 2 months a massive local recurrence had appeared and a second intensive cycle of x-ray therapy was given. A full course of injections of Coley's serum was administered intravenously. The lesion did not regress, the pain and disability of the extremity increased and in November 1937 the relatives of the patient were informed that the prognosis was hopeless and that nothing further could be done. The pain was agonizing so that morphine sulfate in one fourth grain doses every 4 hours gave no relief. No active motions of the shoulder joint could be carried out, attempts at passive motion proved exquisitely painful. The skin overlying the shoulder and right side of the chest, anteriorly and posteriorly was edematous and deeply pigmented from excessive radiation. The axilla was filled with a hard, immovable tumor about 12 inches in diameter.

The physical examination other than that described was essentially negative. The Wassermann and Kahn tests were negative, the red blood count was 4,460,000, white blood count 10,500 and hemoglobin 70 per cent. Roentgenograms of the chest showed no evidence of metastases. The roentgenogram of the shoulder January 18, 1938, showed an enlargement of the soft tissue axillary mass, increased periosteal proliferation in the metaphysis and cortical and medullary atrophy of the entire shaft of the humerus (Fig. 2).

This neoplasm had proved radioresistant and the tissues were already so edematous from excessive radiation that continuation of this treatment was contra-indicated. The patient begged to have the painful limb removed. Because of the absence of pulmonary metastases, it appeared that the youth was entitled to interscapulothoracic amputation and he was referred to the orthopedic clinic for this procedure.

The forequarter amputation was performed on February 2, 1938, under ethylene and ether anesthesia according to the typical Berger technique. With the patient in the dorsal recumbent position a 4 inch incision was made horizontally along the middle of the right clavicle and deepened to the periosteum. The sternoclavicular junction was then divided and the clavicle retracted forward and outward. The axillary and subclavian arteries were palpated, the subclavius muscle was incised and the artery and vein were exposed (Fig. 3). This was the most difficult and time consuming part of the operation and was accompanied by considerable bleeding. After exposure first the subclavian artery and then the vein were each doubly ligated and divided between ligatures. The remainder of the procedure was practically bloodless. The 3 large trunks of the brachial plexus were then separately infiltrated with 2 per cent novocain and were divided. The lateral end of the incision was continued in racket fashion to encircle the axilla. The pectoral major and minor muscles were cut across. The extremity was then rotated anteriorly and the

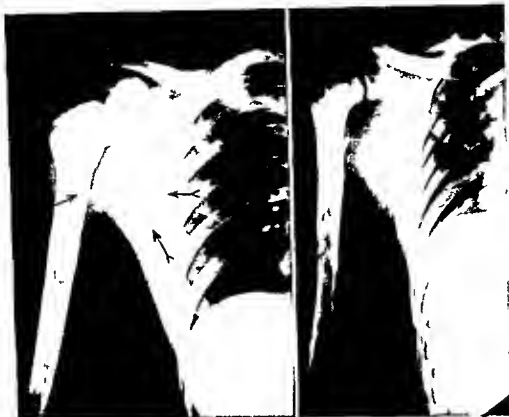


Fig 1 left Roentgenogram June 1937 of chondrosarcoma of right humerus Note periosteal proliferation of the axillary border of upper metaphysis of the humerus and extensive soft tissue axillary tumor (Courtesy Dr Fred Shapiro)

Fig 2 Roentgenogram January 18 1938 showing enlargement of the axillary mass increased periosteal proliferation and marked cortical and medullary decalcification of diaphysis of humerus

posterior skin flap was raised. The trapezius muscle was divided then the levator scapulae and the rhomboid muscles. Finally the serratus magnus and latissimus dorsi muscles were exposed and cut. The entire extremity remained attached only by the slender omohyoid muscle and some of the outer fibers of the trapezius which were divided releasing the specimen consisting of the entire forequarter. The remainder of the pectoral muscles and axillary content were removed. This left the entire thoracic wall devoid of its muscular coverings. A dependent cigarette drain was left *in situ* and the skin flaps were united by black waxed silk and silkworm gut sutures. Five per cent glucose in saline was administered intravenously throughout the operative procedure. A total of 2 000 cubic centimeters being absorbed. Because of a mild degree of shock (the blood pressure dropping from 160/80 to 120/100 and the pulse accelerating from 80 to 110) 500 cubic centimeters of citrated blood were given as a transfusion after operation.

The postoperative course was uneventful. The day after the operation the patient was free of pain and profoundly grateful for the amputation. He was up and about on the seventh day and home on the fourteenth. The wound healed by primary intention. The patient at the time of writing is free of disease (Fig 4).

Gross section showed that the tumor was confined to the humerus and closely surrounding soft tissues and had not invaded the musculature closest to the skin or to the thoracic cage (Fig 5). The histological structure was that of a chondromyxosarcoma (Fig 6). The axillary contents showed no evidence of tumor.

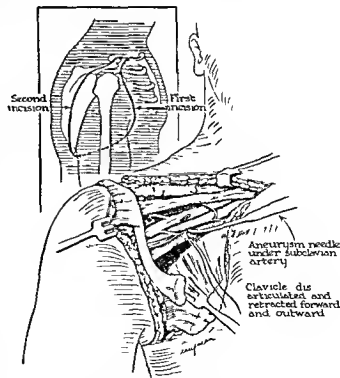


Fig 3 Anterior approach for interscapulothoracic amputation isolation of axillary and subclavian vessels. Inset shows racket incision.



Fig. 4 H. Photographs 2 weeks after operation

This mutilating operation is fortunately an infrequent one. According to Mueller there were but 315 recorded cases up to 1907. The operation was first performed by Ralph Cummings in 1808 for a gunshot wound of the shoulder. The technique was independently perfected by Esmarch in Germany and Berger in France at about the same time (1887). The name of the latter has become attached to the operation and most text books of surgery now refer to it as the Berger amputation. Ollier in 1884 was the first to recommend preliminary ligation of the subclavian artery as the first step in the operation following resection of the medial portion of the clavicle. This represented the greatest advance in the simplification of the operation for it becomes a practically bloodless procedure once the major blood supply has been controlled.

Radioresistant malignant neoplasms of the upper portion of the humerus especially with extension into the shoulder joint or axilla similar tumors involving the scapula or outer portion of the clavicle with axillary involvement and primary radioresistant tumors confined to the axilla constitute the major indications for the performance of this operation. Most of the neoplasms necessitating this procedure have been histologically well differentiated sarcomas as the fibrosarcoma chondrosarcoma or osteogenic sarcoma other histological types have been described including the giant cell tumor (which however occasionally responds well to radiotherapy) and the neuroblastoma. The procedure is especially indicated if there have been multiple previous attempts at local excision of the tumor (as in the

cases of Daland and of Leriche). In a number of cases this operation has been necessary for extensive traumatic lesions of the shoulder region as in Cummings original case. A few cases of intractable tuberculous or staphylococcal osteomyelitis about the shoulder joint that had not responded to less major surgical procedures have come to interscapulothoracic amputation. Mueller and Milch have written extensively on this particular indication.

First suggested by Franke in 1913 for trouble some edema axillary or retroclavicular metastases following radical mastectomy for cancer of the breast the interscapulothoracic amputation for this purpose has been popularized within the past 10 years by the French school particularly Prudente Berard and Dargent. The latter have reviewed the literature on the subject exhaustively and maintain that the operation has been performed at least 16 times for fixed axillary recurrences following surgery for cancer of the breast. Of these 16 5 per cent died at operation 50 per cent developed later metastases, and only 1 case is known to have survived the procedure for as long as 4 years. Prudente who performed this operation 5 times for such recurrences specified particularly that it should not be undertaken in the presence of advanced ulcerating local recurrences fixed chest wall or pleuropulmonary metastases or fixed retroclavicular glands. Certainly the operation should not be undertaken too lightly for this particular group of cases.

The immediate mortality following interscapulothoracic amputation has varied among numerous surgeons from the 5 per cent originally



Fig 5 Gross specimen of chondrosarcoma of humerus



Fig 6 Photomicrograph of chondromyxosarcoma of humerus

claimed by Berger to 20 per cent recorded by others (18, 22) Preliminary subclavian vessel ligation, modern aseptic methods and control of operative shock, as by the injection of novocain into the cords of the brachial plexus preliminary to severing them, and the judicious use of stimulants and parenteral fluids during operation have done much to lessen the operative dangers of this amputation

To justify the acceptance of such a mutilating procedure it must afford a reasonable expectation of prolonging life in addition to alleviating pain Jembreau and Riche maintained there was an average life duration of at least 35 months following such amputation Kawamura claimed 31.3 per cent of a large series of cases remained free of recurrence from several months to 16 years Romanovsky, on the other hand, observed recurrences in 66 per cent of his cases In the American literature Jackson's case is outstanding His patient was well for 13 years following interscapulothoracic amputation for chondrosarcoma before developing extensive local recurrence and intra thoracic metastases There are, in addition, numerous individual cases remaining well from 1 to 5 years after this operation such as the cases of Lenche, Fischer, Daland, and Turco

An analogous operation is sometimes performed for extensive disease, benign or malignant, of the proximal portion of the thigh where hip disarticulation will not completely eradicate the disease This is known as the interilio abdominal amputation Occasionally, this operation becomes necessary for malignant bone tumors of the ilium or tumors of the soft parts of the outer surface of the pelvis extending into the hip joint and femur Speed lists among the indications for this mutilating operation extensive dissecting aneurisms of the femoral artery and crushing injuries of the hip region with gas bacillus infections The operation consists in the extraperitoneal removal of one half of the pelvic girdle with its attached lower extremity According to Riswach this operation was first performed by Billroth in 1889, his patient dying several hours after operation Jaboulay gave an exact description of the operative technique in 1894 Judin found in the literature 74 cases of this amputation reported prior to 1926 At least one fourth of these cases are recorded in the Russian literature As would be expected, the mortality associated with this operation is tremendously high, 44 of the above 74 cases failing to survive the operation

A number of improvements in the technique of the interscapulothoracic amputation have been suggested Most of the operators, like ourselves, have encountered considerable troublesome bleeding in the attempt to expose the subclavian vessels This is often doubly difficult because of previous local operations or excessive radiation leading to a sclerotic fibrosis of the areolar tissues surrounding the major vessels In addition, the vein lies anteriorly to the artery and is often inadvertently torn in the attempt to isolate the former

THE TREATMENT OF CHRONIC EMPYEMA BY CONTINUOUS HIGH VACUUM SUCTION

J V H NEVILLE MD Forsyth Montana

IN the latest issue of a journal devoted to thoracic surgery there were many articles describing various methods of the unroofing or thorocoplastic operations for the collapse of chronic empyema cavities. Because of the uniform and almost unanimous opinion that such a tremendous operation is essential to obtain results I am pleased to submit an alternative method requiring little or no operative surgery together with a case report of a man slowly wasting away with empyema of 2½ years standing to substantiate the theoretical and practical possibilities of this method.

There may be a tendency because a disease occurs only infrequently to treat it inadequately. Few if any procedures in thoracic surgery have become standardized to such a degree that further development would become unlikely or impossible. This in particular refers to the treatment of chronic empyema, a disease about which there is no question as to the objective the treatment should attain but the means of obtaining this objective is a field which remains as yet within the scope of experimental surgery. Any procedure or device which even in a minor way contributes to the treatment of this discouraging condition is of distinct importance. The purpose of this paper is to record the theoretical and practical proof of a method of treating chronic empyema. A minimum of operative surgery is required and it is entirely possible that in some cases the patients would require no surgical procedure whatsoever.

Regardless of the method applied the objective—the obliteration of the cavity—remains constant in the treatment of chronic empyema. We attempt to cause the walls of the cavity to approximate one another to coalesce to heal and thus to obliterate the space. The cavity ceases to exist and is cured. The objective then is to move over one side of the wall to approximate the opposite wall and to keep it there until the two walls unite or to interpose a second tissue into this space such as muscle flaps or granulation tissue thus obliterating the space with the aid of the new tissue. To effect this objective in the safest surest and easiest way possible is still a moot question.

When one considers the architectural pathology of a chronic empyema cavity and the tissues involved it becomes increasingly obvious why this disease remains such a difficult condition to cure with any degree of certainty with even the most extensive and heroic operations. One would be apt rather than call it a disease to consider it a pathological syndrome whereby the structures involved and the natural reactions of the tissues during repair are the very factors which spontaneously defeat the complete repair. To elucidate it is only necessary to consider the pathological developments evolving in empyema.

In the formation of acute empyema the pus separates the two sheets of pleura that on the inner chest wall and that on the outer surface of the lung. The lung is displaced inward to accommodate the pus and a layer of fibrin forms on the pleura in contact with the pus. If the pus is removed early the breathing forces blow the elastic lung back into the concavity of the ribs. They unite and adhere and the condition is cured in the majority of cases if the pus has been over come biologically and the evacuation has been accomplished efficiently.

If the pus is not removed or is only partially drained the fibrin becomes organized granulation tissue forms over the surface of the pleura and the outer surface of the lung which has been compressed becomes progressively more fibrous. What had formerly been a thin flexible membrane slowly but with increasing thickness becomes an unyielding firm wall with no elasticity. The periphery of the lung which formerly occupied the concavity of the ribs becomes inflexible and shortened. If we assume that the inner curve of the ribs is a circle then it is geometrically certain that a chord cutting that circle is necessarily shorter than the segment it cuts. In like manner the lung moved inward by the pus and then solidified in this shortened condition is no longer of sufficient length to fit where it belongs even if means were available to place it there.

If there are no methods of stretching this tough fibrous tissue wall and of holding it firmly against the outer wall until union is accomplished we



Fig 1 Roentgenogram of chest on admission



Fig 2 Roentgenogram 10 days after suction treatment

overcome the dilemma by shortening the curved outer wall to such a degree that it would approximate the inner wall and have an opportunity to heal. This is the thorocoplasty or unroofing operation and is the most reliable means we have used to close the cavity of chronic empyema.

The facts mentioned are but the structural or mechanical causes which tend to prevent any simple means of cure. Of equal importance in delaying cure is the biological tendency of the tissues involved. The tissue which lines the walls of a chronic empyema cavity is perfectly analogous to the tissues of a surface wound elsewhere on the body. An open surface wound, uncovered by skin or mucous membrane has one predominating characteristic which is the crux of the situation in an empyema cavity the same as on a surface wound. When we speak of a surface wound as being healed, we mean that it has become covered with skin. Until it does become covered it remains moist, weeping, infected, and constantly forms pus.

Skin extends out over the wound from the healthy edges in an attempt to place the wound surface cells where they belong, namely, beneath the surface. Sub surface tissues have not the inherent properties of withstanding infections when they are accidentally placed in this strange surface environment. They continue to remain infected

until skin covers it. The action of fibrous or scar tissue which forms and then contracts, assists in drawing the skin edges closer together. The time necessary for a surface wound to heal, therefore, is regulated not so much by the kind or degree of the infection, but by the time necessary to cover the wound with skin. It is a commonly known fact that a wound takes much less time to heal if the skin edges are pulled together even though the wound is yet infected, provided of course that gross drainage is controlled. The fact that the lining membrane of an empyema cavity is similar to an open, uncovered wound is the reason for the constant accumulation of pus. As long as the cavity exists, there will be a surface infection the drainage of which is within the cavity itself with the constant access to auto infection. This process continues until the cells which form the lining membrane of the cavity are placed beneath the surface where they belong. This is accomplished by holding the two walls of the cavity together until they unite. What formerly was a surface membrane is now beneath the surface and healing ensues.

The outer wall of the cavity, because of its ribs, is the firmest part of the wall. From a structural viewpoint it would be more rational to allow this wall to remain as it is and move the inner wall, the side toward the lung, outward to the



Fig 3 Roentgenogram 3 weeks after suction treatment Sinus partly filled with lipiodol



Fig 4 Roentgenogram showing track 4 weeks after suction treatment

other wall. This for obvious reasons has always been an impossibility. An approach in this direction has been attempted by insisting on blowing exercises by the patient. This procedure was of little practical importance except possibly in re-expanding the lung after drainage in acute empyema before adhesions have formed.

The atmospheric pressure acts equally on all surfaces and with relation to an empyema cavity the pressure thrust is the same within the interior of the cavity as on all parts of the external wall of this cavity. If the pressure within the cavity is reduced there is an unopposed pressure on the external surface of the walls toward the center of the cavity. The more the interior pressure is reduced the greater will be the effect of the atmospheric pressure on the external walls of the cavity. Because of the resistance of the ribs which are better able to withstand the air pressure without displacement the inner wall due to the air pressure thrusting on it through the respiratory passages would be displaced outward to the outer wall. If the weight of 50 miles or so of air could be directed with regulation on the medial wall of the cavity for a sufficiently long period it was foreseen that the cavity walls would be squeezed together with eventual obliteration. The problem was to develop a means of reducing the air pres-

sure within the cavity over a long period, allowing the atmospheric pressure to exert its weight on the external surfaces of the walls. Because the walls were reinforced by ribs on the outside and were thick and leathery on the inside it was recognized that nothing less than considerable physical force acting for an indeterminate period of time would be effective. The physical force referred to is that of the atmospheric pressure unopposed. To obtain the squeezing or compressing action of the most uniform, the most gentle and yet one of the strongest of all forces it is necessary to remove the air pressure from the interior of the cavity by suction. A further possible effect of suction applied to the interior of a cavity is that it will cause a congestion of the walls and if enough suction is applied it will produce oozing. This oozing would be conducive to formation of granulation tissue which would assist in filling up the space and enhance healing.

Several modes of using suction in the treatment of empyema, both acute and chronic, have been familiar for years. It was obvious that suction from the syphon bottle system was useless because of the low degree of suction possible and the constant attention necessary. Suction from water faucet syphons is also impractical because of the tremendous amount of water necessarily



Fig 5 Roentgenogram showing narrowing of track 6 weeks after suction



Fig 6 Roentgenogram showing shortening of track at 7 weeks

wasted to obtain only a relatively low degree of suction. It was also impossible to think of using the standard tonsillectomy sucker because neither the patient nor the machine would tolerate such high speeds 24 hours a day, week after week.

An entirely new instrument was developed which corrected all the defects of other systems and fitted itself perfectly to this particular problem and an unforeseen number of other situations. The instrument consists of a vacuum storage tank whose vacuum is developed by an electric suction pump which automatically cuts in when the negative pressure is below 5 inches of mercury. The pump operates until the vacuum is built up to 17 inches of mercury and then the motor is automatically cut off until this vacuum has been utilized down to 5 inches again. An almost noiseless motor and pump can build up this vacuum in about 30 seconds to a minute, and for chest cases this amount will last for 5 to 6 hours depending on the type of application. When the instrument is used for other purposes such as duodenal suction, external duodenal fistula, or vesicovaginal fistula the motor necessarily operates more frequently because there is a continuous flow of vacuum for evacuating purposes. The vacuum applied to the patient is controlled to any amount of pressure by means of a reducing

valve, vacuum gauge, and bubble indicator. The control of this vacuum is absolutely exact and the instrument may be operated continuously for months without any further attention than plugging it into an electrical outlet and emptying the catch bottle. The instrument is designed primarily to deliver a high degree of vacuum, delicately controlled, and continued over a period of time which could possibly extend for a month or more. This instrument is light and compact and occupies a space of approximately that of a standard typewriter. There is an almost inaudible motor hum, lasting at the most a minute once every few hours so that there is no annoyance whatsoever to the patient. When the connection is plugged into the electric outlet, aside from regulating the flow with the reducing valve, there is no further attention necessary. Although the utility of this instrument in chest cases is particularly stressed in this paper, it is equally successful in other fields of surgery, such as gastric lavage, decompression of duodenum and intestine utilizing duodenal intubation, common duct drainage from a T tube, and urinary bladder drainage following prostate and vesicovaginal surgery. It was found to be the instrument of choice in postoperative external gastric or duodenal fistulas.



Fig. 2. Roentgenogram showing track almost obliterated 8 weeks after treatment.



Fig. 3. Roentgenogram of chest after patient was discharged and cured.

The only difficulties found in the use of high continuous suction is that of correct size of rubber tube. Some tubes which will carry fluid are porous to air and will not hold a vacuum. A tube with too small a bore will soon plug due to a solid fragment clogging it or to the accumulation of deposit which is laid down within the tube. A tube with too large a lumen will allow air to pass through it without carrying along the fluid in the tube. One opening in the end of the tube such as is used in the ordinary catheter is much more liable to clog with fragments of debris. For best results it is necessary to make many auxiliary openings in the sides of the tube at the terminal 2 or 3 inches. It is also necessary in applying a suction tube into a chronic empyema cavity to have an almost air tight fit at the entrance of the draining tract. This is obtained by enlarging the tract surgically and using a tube sufficiently stiff and of such a diameter that it is inserted into the tract with difficulty and if there is leakage about the tube during the first few days the contraction of the tissues soon forms a much closer fit.

While it is a modern tendency to express opinions only after the summation of a formidable array of statistical data it is none the less true that one single isolated case beforehand may be the index of what a large series may prove at a

later period. I mention this fact as an excuse for daring to publish a paper with but a single case in point. No bibliography is appended to this paper because no record could be found of chronic empyema having been treated by this method. It should be fully understood that suction drainage in empyema acute or chronic is well known and has been utilized for years whereas no method has been discovered whereby a high vacuum amounting to 15 inches of mercury has been applied to the chronic empyema cavity for a period of 5 to 6 weeks. Previous uses of suction in chronic empyema have been solely for the removal of drainage whereas this paper describes only the use of a high vacuum not only for the removal of any collection within the cavity but also for the collapsing of the thickened walls of the cavity by the high degree of suction obtained.¹

CASE HISTORY

Mr. G. I., a white laborer, 52 years of age, was admitted to Rosebud Memorial Hospital on October 20, 1937, with a previous diagnosis of chronic empyema. There was no family history of tuberculosis nor any other illness of significance.

In July, 1935, the patient became ill suddenly with pain in his right chest on breathing. He developed a fever with

Det. als reg. ading th. w. cu. pa. t. m. be. bt. ed from th.
P. rect. M. f. t. n. g. c. mp. j. M. polis.

chills and sweats. He is quite certain that he did not have a cough or pneumonia at the beginning of this illness and what cough he did have came on subsequent to this illness. The pain was generalized over the right side of the chest and in the course of some weeks settled particularly in the right upper chest. A loose cough developed with night sweats. He began to raise sputum and the pain in the side continued. He lost weight gradually and was confined to bed. He was certain that he had a high fever every day. After some weeks his chest was aspirated and pus was obtained.

On August 3, 1935 a rib resection was done under local anesthesia. A drain was placed in the pleural cavity and considerable foul smelling thick pus and gas were obtained. He had made a satisfactory partial recovery when he was discharged September 28, 7 weeks following the rib resection with a final diagnosis of empyema and bronchial fistula occasioned probably by a primary pneumothorax. Since that time which is 2 years and 6 months since the original operation he has been an invalid with a constantly draining sinus. The pus has always been foul and he has continually worn a dressing. There had been at attempts made to cure his sinus by the injection of oil. If at times it became temporarily closed he would develop chills and become acutely ill until the sinus would break and discharge.

He was admitted to the Rosebud Memorial Hospital on October 20, 1937 weighing 118 pounds while his average weight was 148 pounds. His general condition was very poor. His skin was gray and a foul discharge permeated the room. He gave the above history and stated there were about 1 to 2 ounces of pus on his dressings each day. Chief complaints were draining chest sinus, continuous loss of weight, weakness, chronic cough and recurrent elevation of temperature.

The general examination revealed the following: Temperature 100.5 degrees, pulse 86. The tonsils were buried, pillars reddened, four lower incisors showed extensive pyorrhea. There were no neck abnormalities. Left chest appeared normal. Right chest contracted with all ribs showing. At level of tenth ribs at the posterior axillary line there were 3 openings which continuously discharged foul thick pus. There were deep supraclavicular and infraclavicular depressions. Blood pressure 118/72. The abdominal examination and examination of extremities revealed nothing. Red blood count was 3,700,000 and the white blood count 14,200 per cubic millimeter. Hemoglobin was 58 per cent, urine was normal. Roentgenograms of the chest are illustrated in Figure 1. The Mantoux test and the test of sputum for tuberculosis were negative.

Lipiodol was injected into the sinus followed by roentgenogram to determine the length and direction of the sinus. It required too much lipiodol to fill the whole cavity although the length and direction of the sinus is well illustrated in Figure 2. It is impossible to determine accurately the cubic capacity of this type of cavity by the amount of fluid it will hold for the reason that when the fluid is injected up the track it is impossible to fill the track completely because the air cannot be thoroughly evacuated to allow a complete filling of the space. A diagnosis was made of chronic empyema with insufficient drainage. Under local anesthesia an incision was made 3 ribs above the opening of the sinus. Three inch sections of seventh, eighth and ninth ribs were removed to allow exploration of the cavity. Considerable grumous material and pus were aspirated from the depths of the cavity and a probe could be entered into the cavity as high as the apex of the thoracic cage and inward to the upper part of the mediastinum. The cavity walls were thick and unyielding. A rubber tube with several side openings and about three

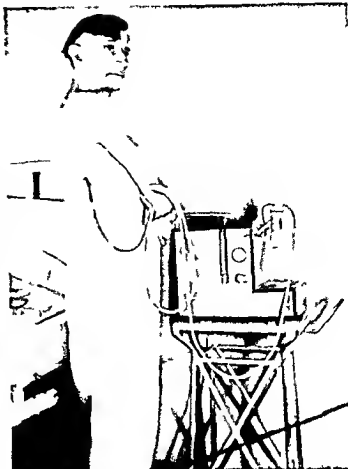


Fig. 9 G I. After 3 weeks high vacuum suction showing an early model of vacuo aspirator.

quarters of an inch in diameter was then forced into the opening and placed well into the cavity. The incision was then closed loosely over the tube. The operation was for the purpose of exploring the track and cavity and for the insertion of a tube of suitable size for high vacuum treatment.

When he was returned to his bed constant suction was applied to the cavity through the tube from the vacuum aspirator. Suction was begun at 2 inches of mercury and maintained 24 hours each day. An infant catheter had been inserted through the wall of the large tube and sealed with auto tire cement. This allowed irrigation of the cavity with Dakin's solution several times a day. With the negative pressure already in the cavity the irrigating fluid entered under the force of suction and very thoroughly washed out any further collections of pus and debris. Each day the degree of suction was increased and the cavity was irrigated. When the vacuum reached the degree of 10 inches of mercury and oozing of blood into the receiving bottle was noticeable the suction was reduced in degree until the oozing ceased. In a few days it was found that suction could be increased to the previous degree without oozing of blood and such was done. There was some leaking of air between the tube and sinus wall for the first few days. Many substances were tried to stop this leakage but were to no avail and later it was apparent that due to the suction and to the natural contraction of

¹At the present time it is possible to obtain this type of drainage tube incorporating the irrigating channel from the American Cystoscope Makers.

the track the air leakage ceased in a few days without further attention.

The patient was given a high caloric diet with forced feeding. His teeth were attended to and he was given iron and vitamin tonics. The tube from the vacuum aspirator was long enough to allow him complete freedom of his room and he soon learned to regulate the vacuum aspirator to any desired degree of suction and became highly interested in the treatment. He was allowed to disconnect the suction for sufficient periods during the day to eat his meals and for toilet facilities after which he re-applied the suction himself. For the first 2 weeks when the suction was applied he could feel the vacuum gripping the interior of his chest causing some little discomfort with some aching in his right arm but which did not require opiates. The tube was changed once a week more from curiosity than from necessity. Each subsequent x-ray picture showed a difference not only at the site of the cavity but also in the remaining lung field, the clear area of which increased at each examination. After the first week there was very little drainage from the track which we attributed to the extreme efficiency of both drainage and irrigating systems which sterilized the cavity to a great extent. There was seldom more than a half to one dram of drainage in the bottle each day. After 4 weeks of continuous suction the cavity had been reduced to nothing more than a straight track which was fully occupied by the drainage tube as illustrated in Figure 2.

At this time the sinus consisted merely of a track only large enough to hold the catheter. The suction was continued and the catheter was withdrawn about an inch every

few days. When the length of the track remained about 4 inches it was deemed sterile enough for spontaneous closure. The patient was discharged and returned 1 month later for examination. The sinus had stopped draining entirely and was completely healed. He had not had elevation in temperature for 2 months. His weight had increased since the beginning of the treatment. At the present writing which is 7 months since he was discharged the patient states that he is doing clerical work every day and has had no sign of discharge or his previous illness whatsoever. He is completely cured and extremely happy with the result.

CONCLUSION

A case is presented of a man incapacitated for 2 years and 6 months with chronic empyema whose weight and strength were decreasing constantly. The patient was completely cured by the use of continuous high vacuum suction applied to the interior of the cavity. A short description of the instrument perfected for this and all types of continuous suction is included with illustrations. It is recommended that this method be given a thorough trial before extensive and hazardous operations be resorted to for chronic empyema.

DIRECT INGUINAL HERNIA AND A METHOD OF FASCIAL REPAIR

EDWIN H. CARNES, M.D., F.A.C.S., Memphis, Tennessee

THE pathology of direct inguinal hernia is totally different from that of indirect or oblique inguinal hernia. A thorough understanding of the pathology is necessary if operation for repair of direct hernia is to be successful. That it has not invariably been understood and recognized is indicated by the relatively high recurrence rate in this type of hernia, as well as by the type of operation frequently seen performed or described. In the hands of competent surgeons the percentage of recurrence varies from 7 to 30 per cent and Andrews states that in about one fourth of the cases operated upon for this type of hernia, the patient is made definitely worse by surgery.

PATHOLOGY

According to the usual textbook descriptions, the internal oblique muscle inserts into the lower borders of the 3 lower ribs, into the rectus sheath of which its aponeurosis forms 2 layers, and conjointly with the transversalis muscle into the pubic crest and pectineal line immediately behind the external inguinal ring. The conjoint tendon thus formed "serves to protect what otherwise would be a weak point in the abdominal wall (6)".

Recent investigations of the anatomy of the inguinal area lead the investigators (2) to believe that the conjoint tendon or aponeurotic falx as so described does not exist and that the structure so regarded and used by some surgeons in the repair of the inguinal floor is "merely an area in the anterior lamina of the rectus sheath rendered more prominent than the surrounding tissue through its insertion into bone".

In the type of individual prone to develop direct inguinal hernia there is often deficient development of the internal oblique muscle, particularly its lower border. Further, instead of its fibers becoming tendinous and inserting into the pubic crest and pectineal line its only insertion is into the rectus sheath at variable distances from the pubic crest.

This high insertion results in the formation of an inguinal triangle bounded by the rectus sheath, the lower border of the internal oblique muscle, and the inguinal ligament. This arrangement leaves a vulnerable spot in the inguinal floor which has for its support only the peritoneum

and transversalis fascia. Anson and McVay, by measuring 95 unselected specimens, found that the length of the medial wall of the triangle, i.e., the distance from the insertion of the lower border of the internal oblique muscle to the pubic crest varied from 0 centimeters to 9 centimeters, 48 of the cases measuring between 2 centimeters and 5 centimeters.

We have found in practically all of our cases of direct hernias that the length of the medial wall ranges from 2 centimeters to 4 centimeters. It is obvious, therefore, that if repair is attempted by suture of the "conjoined tendon" to the inguinal ligament, approximation of the apex to the base of a triangle is being undertaken. The muscles forming the apex will very promptly raise it again, with resultant weakening of the inguinal floor and probable recurrence of the hernia.

In addition to the pathology already present, the external inguinal ring is, in our experience, nearly always enlarged, so that operative procedure relying largely on the aponeurosis of the external oblique muscle for reconstruction of the inguinal floor will find this structure inadequate at the most important point, namely, the lower portion of the inguinal area. It is here that most recurrent hernias are found.

Harris and White, in an interesting investigation of the length of the inguinal ligament in direct and indirect hernia, measured this ligament in 500 patients. They found that individuals with an inguinal ligament of less than 11 centimeters had slight tendency toward the formation of inguinal hernia of either type and that hernias occurring in individuals whose inguinal ligament measured from 11 to 15 centimeters were of the indirect type, while in those whose ligaments were from 15 to 19 centimeters the hernias were of the direct type. They found, further, that the longer the inguinal ligament, the deeper the pelvis, and conversely, the shorter the ligament, the shallower the pelvis. Their conclusions in regard to the formation of direct hernias were that in cases in which the inguinal ligament was long, there was relative shortening of the distance between the anterior superior iliac spines with greater inclination of the pelvic floor, thus causing intra-abdominal pressure to be exerted mainly near the midline, producing the direct type of hernia.

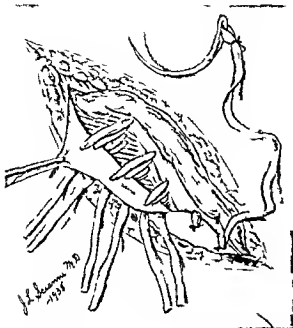


FIG. 1 The fascia has been disposed of the transversalis fascia has been closed and reconstruction of the inguinal wall has begun



FIG. 2 Reconstruction of the inguinal wall has been completed by the overlapping of the aponeurosis

ETIOLOGY

Direct hernia is always acquired that is so far as the hernia itself is concerned. The anatomical defect is already present and intra abdominal pressure gradually produces a bulging through a weak spot in the abdominal wall. It is our opinion that this is a gradual process and that the sudden production of a direct hernia rarely occurs. Its possible extension through the external ring with corresponding spreading of the anatomical structures of the inguinal triangle due to sudden increase in intra abdominal pressure may produce pain and bulging leading to the belief that the hernia is traumatic in origin.

Practically speaking, direct hernia occurs only in the adult male. Less than 1 per cent occur in women. Seward Erdman concludes that the enlarged external abdominal ring is an important factor in the causation of direct hernia in the male.

TECHNIQUE OF REPAIR

Cure of direct inguinal hernia is obtained only if the inguinal triangle is closed completely and permanently. Important factors in effecting such a closure are the selection of such structures for the reconstruction of the inguinal floor as can be approximated without tension, the employment of fascia to-fascia suture as far as possible and the use of fascia lata as described by Galie (4, 5).

The obtaining of fascia lata strips is a simple procedure and is done by an assistant during the course of the operation. A longitudinal incision about 3 inches long is made over the lateral aspect of the thigh approximately at the level of the perineum. Incisions in the same direction are made in the fascia lata about 1 centimeter apart. Across the upper ends of these incisions a transverse incision is made thus freeing the upper portion of the fascial strips. The Bartlett's fascia stripper is then used to free the strips subcutaneously at the same time cutting them off distally after the desired length has been freed. The thigh incision is closed with a few skin sutures or clips. For convenience of the operator and assistant the thigh opposite the side on which hernia repair is being done is used. One end of a fascial strip is threaded through a Galie needle for a distance of about 15 centimeters and secured by a suture of fine silk. Care is taken to avoid bulk at this point if necessary the threaded end of the strip is trimmed with scissors. The prepared strips are then placed in a small covered tray between layers of gauze moistened with saline until needed by the operator who in the meantime has proceeded with the operation at the site of the hernia.

Incision for the hernioplasty is made so as to expose the pubic spine below and extend some

what cephalad to the internal ring above. The aponeurosis is exposed and incised into the external ring, the incision being nearer the lateral than the medial pillar of the ring. The cord is pulled up, isolated, examined for a possible indirect sac, and retracted lateralward.

The sac is located and the condition of the transversalis fascia is noted. If this structure forms a definite continuous layer over the sac it is incised. The sac is picked up and the preperitoneal fat is carefully dissected away, particular caution being observed to avoid damage to the bladder which often lies on the medial wall of the sac. The peritoneum of the sac is opened and the redundant portion is cut away. As the direct sac usually has a broad base, closure is best achieved by a continuous or purse string suture. For the same reason, in some instances the sac may be treated by incision with a purse string suture without being opened.

As a preliminary step in the reconstruction of the inguinal floor or wall, closure of the transversalis fascia, which frequently is well developed and of considerable strength, provides an additional layer and strengthens the new wall to that extent. Closure may be effected by suture of the rent frequently found in this layer, or of the incision made in dissection of the sac with fine chromic catgut, or, if bulging, the redundancy may be disposed of by a purse string suture. Sometimes the upper portion is strong and well developed, the lower portion thinned out and weak, in such cases the upper and stronger portion is brought down without tension and included in the suture to be described. It seems reasonable to assume that smooth closure of the transversalis fascia in addition to providing an extra layer of some strength serves to distribute the stress of intra abdominal pressure evenly against the outer layers of the wall under construction.

To obtain the next layer for the reconstruction a curved incision is made along that portion of the anterior rectus sheath posterior to the aponeurosis of the external oblique. This incision is made near the lateral margin of the rectus sheath and extends cephalad from the pubic crest for 4 or 5 centimeters, curving slightly outward. Adequate exposure of the sheath, consisting at this level of two of its three layers, is obtained by medial and forward retraction of the aponeurosis, its third layer. The portion of the sheath lateral to the incision is drawn lateralward by traction on its cut edge and sharp dissection from the underlying rectus and pyramidalis muscles. This procedure furnishes a fascial flap which can be approximated without tension to the lower portion of the ingui-

nal ligament thus covering a most vulnerable area. Due to enlarged external rings present in most cases, overlapping of the aponeurosis of the external oblique does not always provide a strong, firm closure, hence the addition of the rectus sheath flap to the constituents of reconstruction. The anterior sheath appears to be adequately replaced by the medial leaf of the aponeurosis, the edge of which is to be sutured to the shelving edge of the inguinal ligament.

The component parts for the reconstruction of the inguinal floor having been exposed, suture is begun, with strips of fascia lata as suture material. Interrupted sutures are inserted as shown in Figure 1. Starting at the lower end of the inguinal ligament the first suture or fascial strip is passed from without, i.e., lateral and inferior to the ligament under its shelving edge. It is next passed through the rectus sheath flap near its free margin and also through the transversalis fascia if this structure is available and not previously closed by an alternate method. The direction of the needle being reversed, it is passed through the shelving edge in a direction away from the femoral vessels, then back through the medial leaf of the incised aponeurosis near its free margin, thence through the lateral leaf just above the shelving edge of the inguinal ligament. In insertion of the first suture a portion of the periosteum of the pubic spine is included. The end of the strip is clamped, the needle is left on, and the exposed strip and needle are protected by gauze. Other fascial strips, slightly more than a centimeter apart, are inserted in this manner to the internal ring. In the upper part of the inguinal floor, the lower borders of the internal oblique and transversalis muscles are used instead of the rectus sheath, as these muscles can be approximated to the shelving edge of the inguinal ligament in this location without tension.

After insertion of all the fascial sutures, starting with the lowest, traction is made on both ends, and a silk suture is passed through the ends at the level of the aponeurosis and tied twice so as to include the entire width of both strips. The short end is cut off slightly more than a centimeter from the silk suture, the long end carrying the needle is left for further use. The other strips are secured similarly, both ends being cut off, however. Traction on the lower or originating end of the fascial strip approximates the innermost layer of the closure, whereas traction on the upper or emerging end of the strip brings over to the inguinal ligament the medial leaf of the aponeurosis, so that accurate apposition of the inner layers can be obtained and inspected before these layers are cov-

ered by the medial leaf of the aponeurosis. The lateral leaf of the aponeurosis is then overlapped (Fig. 2) being sutured to the surface of the medial leaf with the fascial strip first inserted, the needle having been left on for this purpose. The aponeurosis is closed above the internal ring by one or two interrupted sutures if necessary. The subcutaneous fascia and fat are closed carefully over the cord which lies outside the aponeurosis and the skin is closed after careful hemostasis.

This method of closure reconstructs the inguinal floor in its lower part, the vulnerable point for recurrence, with 4 fascial layers: the transversalis fascia, the rectus sheath and the 2 overlapped flaps of the aponeurosis. Closure is further reinforced by the use of fascia lata in approximating and overlapping these structures.

Needless to say, meticulous technique as regards asepsis is necessary, as infection may result in loss of the reinforcing fascial strips. In our experience of over 100 cases repaired by this method, infection has not occurred. To date, no recurrence has been noted, but the method has not been in use sufficiently long to make a definite

statement as to recurrence. It is felt, however, that a method employing structures that are for the most part fascial in origin and that can be approximated without tension will result in a minimum of recurrences. It is our opinion that the use of fascia lata definitely reinforces the closure and is therefore, an important factor in the prevention of recurrence.

BIBLIOGRAPHY

1. ANDREWS, EDWARD and BISSELL, ARTHUR D. Direct hernia. A record of surgical failures. *Surg. Gynec. & Obst.* 1914, 58: 753-761.
2. ANSON, BARRY J. and McVAY, CHESTER B. Inguinal hernia. I. The anatomy of the region. *Surg. Gynec. & Obst.* 1935, 66: 186-191.
3. ERDMAN, SEWARD. Hernia. *Nelson's Surgery*, Vol. 4, Chapt. 6, pp. 540-668A.
4. GALLIE, W. F. and LEMESURIER, A. B. The use of living sutures in operative surgery. *Canadian M. Ass. J.* 1921, 11: 500.
5. *Ibid.* Living sutures in the treatment of hernia. *Canadian M. Ass. J.* 1923, 13: 469.
6. *Cray's Anatomy*, pp. 414-415.
7. HARRIS, FRANKLIN I. and WHITE, ALFRED S. The length of the inguinal ligament in the differentiation between direct and indirect hernia. *J. Am. M. Ass.* 1937, 109: 1900-1903.

EDITORIALS

SURGERY

Gynecology and Obstetrics

FRANKLIN H. MARTIN
Founder and Managing Editor
1905-1935

LOYAL DAVIS, EDITOR

Associates

SUMNER L. KOCH MICHAEL L. MASON

DONALD C. BALFOUR, *Associate Editorial Staff*

AUGUST 1939

ATROPHY OF BONE

EVERYONE familiar with the treatment of injuries of bone, particularly fractures, knows that prolonged fixation with plaster of Paris inevitably leads to atrophy of bone. What brings this about may not be well understood. It is known that stasis of blood in an extremity, voluntary disuse of an extremity, and various types of inflammatory lesions of joints which produce a painful fixation spasm will lead to atrophy of bone. Vascular conditions which cause pain will lead to atrophy of bone because of the painful condition, although ischemia in itself does not produce atrophy of bone but rather causes a sclerotic change in the bone.

Another type of atrophy of bone which is rather well recognized by those interested in orthopedic surgery is that known as Sudeck's atrophy. A rather definite understanding of this condition has evolved through the efforts of several workers, but much remains to be learned about this condition. Certainly it seems in many cases to be a part of a general

symptom complex predominated by some type of vascular neurosis as yet not completely understood.

Between the atrophy of disuse and Sudeck's atrophy lies a group of conditions which are commonly known as post-traumatic painful atrophy and, as a rule, involve bones adjacent to joints and also involve the joints themselves. Some may claim that these conditions are in truth Sudeck's atrophy. Yet one does not see the extreme degree of vascular change usually associated with the more acute forms, usually known as Sudeck's atrophy. Others may feel that these forms of so-called post-traumatic painful atrophy are only forms of the atrophy of disuse, but they often may appear in spite of an amount of use usually sufficient to prevent the occurrence of atrophy.

One could mention many other types of osteoporosis, such as senile osteoporosis, which seems to be seen more often than in previous years. All of these conditions stress the importance of more complete knowledge of the physiology of bone and its pathological reactions to the various changes to which it may be subjected, such as the following: trauma, disuse, and disease.

As our knowledge improves, it is safe to predict a more comprehensive approach to the treatment of many conditions. Besides a more complete knowledge of the physiology of bone, a better understanding of the physiology of the circulation of the extremities must be had before these conditions can be understood. Finally, as our knowledge of the chemical composition of the human bone and tissues and of the physiologic-chemical reaction of bone is improved, much light will be thrown on this interesting subject. RALPH K. GHORMLEY

THE ROLE OF SURGERY IN THE RECOVERY OF THE TUBERCULOUS INDIVIDUAL

TUBERCULOSIS once considered a contra indication to surgical intervention now responds most favorably to this method of treatment. Not many years ago the presence of tuberculosis particularly pulmonary disease frequently deterred surgeons from undertaking necessary surgical operations while more recently many tuberculous individuals have sustained harm from the over zealous activities of an awakened surgical profession. Between these two extremes lies a middle course which offers to the patient maximum possible benefit, yet at the same time protects him from ill advised operative trauma. A better understanding of the problems involved in the treatment of this disease by surgeons and medical men alike will lead to more satisfactory results and a lower operative mortality rate.

Tuberculosis is a constitutional disease which manifests itself clinically by its localizations in various tissues and organs of the body. From the site of original implantation the organisms may become distributed widely throughout the body to form secondary foci from which later develop the symptom producing lesions recognized as clinical tuberculosis. Although commonly single multiple areas of disease occur with sufficient frequency to render routine search for them mandatory. A complete and thorough study of the patient from head to foot must be made in order to discover all tuberculous and non tuberculous disease for it is only through such intensive study that the patient's best interests can be served and a balanced judgment as to proper treatment rendered. Therapy must be directed to the patient as a whole and not merely to a local lesion for complete results.

No field of medical endeavor offers more favorable opportunity for group work than does the adequate handling of tuberculosis in all its protean manifestations. The phthisiologist, internist, surgeon, roentgenologist, cardiologist, urologist, otolaryngologist, bronchoscopist, oculist, proctologist, pathologist and various other specialists may at some time or other be called upon to contribute their share toward rehabilitating the individual. It is eminently desirable that the phthisiologist and internist be surgically minded and appreciate the possibilities of surgical treatment and its modern developments, but it is equally as important that the surgeon either understand tuberculosis, its response to treatment, and the dangers of its dissemination or permit himself to be guided by those who do. It is as unwise for the medical man unskilled in surgical therapy to attempt such work as it is for the surgeon unversed in phthisiology to undertake this type of surgery alone. Each has his own sphere, with close co-operation the keynote to success.

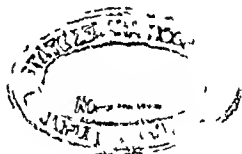
Fundamentally surgery does not cure tuberculosis as it may cure other types of disease for in tuberculosis because of the very nature of the process no single operation or series of operations can completely rid the patient of all foci of the infection. In spite of such limitations it may be and frequently is the deciding factor in bringing about recovery, yet unless the patient possesses or develops that indefinable something known as resistance against tuberculosis he will not conquer the disease even with the best surgical attention. Under suitable circumstances the surgeon may be able to resect an apparently local focus of the disease (nephrectomy, salpingectomy, lobectomy), but even at best he is unable to remove all the process from the local system to say nothing of the whole body. Drainage operations for tuberculous abscess

(psoas, pnenephritic or pleural) may relieve local symptoms but never eliminate all local disease. So much the more do the indirect procedures (spine fusion, thoracoplasty) which do not touch the local lesion but merely alter local function by immobilization or immobilization and compression, fail to relieve the patient of all his tuberculosis although they may aid very materially in inducing recovery. The effect of the surgery is mechanical, altering physiological conditions and correcting physical handicaps to permit the patient to combat the infection under more favorable circumstances. All manipulations should be carried out with the minimal trauma, both surgical and anesthetic, compatible with the operation required. Speed of operation may be of much less importance to the patient than gentleness in handling tissue. If anyone must be handicapped let it be the surgeon rather than the patient. Excessive trauma, hemorrhage, shock, or anything which lowers the patient's resistance may be followed by a flare up or dissemination of tuberculosis.

Blood transfusion may replace blood loss, but it does not compensate for other damage which has been done, and this damage may be considerable.

Tuberculosis is a serious disease, carrying with it a high morbidity and mortality rate. No patient suffering from it has any chances to throw away. Advantage should be taken of any and every method which may contribute even in small measure to the patient's ultimate recovery. A 3 months "cure" of this disease does not exist. Half way measures may delude the patient as well as the physician for a time but rarely gives permanent results. An adequate treatment for tuberculosis should be an intensive composite program in which surgery plays a minor or major part, but never the complete role. Individual circumstances and the well balanced clinical judgment must determine when, where, and how surgery shall be utilized, but adequate constitutional treatment must always be combined with it if best results are to be obtained.

THOMAS J. KINSELLA



22nd Oct/88

Dear Sir

I was absent from England when your letter of the 5th inst. was written. If it is through that my absence from Bethel prevented your very welcome offering of the East of New Brunswick, I would express to you my thanks for any care I

can take a degree for £10 or a donation to the L. Institute

Believe me
Yours truly

Joseph Melcken

J. F. Melcken Esq.

THE SURGEON'S LIBRARY

REVIEWS OF NEW BOOKS

THE appearance of *Cancer Its Diagnosis and Treatment*¹ by Cutler and Buschke marks a new trend in cancer therapy. Medical historians will be able to trace the development of knowledge concerning cancer by the men who wrote the books about it. The foundations of our modern knowledge of the treatment of cancer were laid by outstanding surgeons of the past century such as Warren, Gross, Paget, and Butlin. All of these men took a special interest in cancer and wrote good books about it. The pathologists next dominated the trend of thought about the disease. Borst, Ribbert, Ewing, Masson and Menetrier classified and described its multitude of forms in books of permanent worth. Today radiation has taken an important place in the treatment of cancer and we find the radiotherapists writing books about it.

That by Cutler and Buschke is the first book of its kind to appear in this country. Both of the authors are equipped with a broad knowledge of radiotherapy. They have had the assistance of a third well trained radiotherapist, Simeon T. Cantini. They have written a book of 757 pages which aims to present the essential clinical features and the preferred methods of treatment for the more common forms of cancer. The first chapter deals admirably with the biological effects of radiation and the general principles of its clinical application in cancer. Two short chapters on biopsy and on the spread of cancer follow. Each of the 39 remaining chapters deals with a regional type of cancer. A well chosen bibliography of the more recent papers concerning each form of cancer is appended at the end of the book and a name and subject index completes it.

Many of the 346 illustrations included are good reproductions of roentgenograms while others are well chosen clinical photographs and drawings. The book is printed in clear type on glossy paper.

This book offers a great deal of information concerning the principles and technique of radiotherapy as it has been practiced by Coutard and his associates at the Radium Institute in Paris. The chapters dealing with tumors in the head and neck in particular are the best that have been written in English. The chapters on cancer of the uterus, too, are admirably done. The authors are at home in discussing these forms of cancer for their treatment has in general been turned over to radiotherapy. The pathology of these lesions is comparatively simple and stereotyped and surgery does not often come into consideration.

This cannot be said for other forms of cancer and in dealing with them Cutler and his associates are often inadequate. They lack that thorough familiarity with modern pathology that is necessary to any one who attempts to classify malignant neoplasms. This is illustrated by the manner in which they deal with soft part sarcomas. They have lumped all forms together under the title of "neurogenic sarcoma" and infer that Ewing believes that most fibrosarcomas, liposarcomas and myosarcomas are of "neurogenic" origin. The authors also display in many places in their book a lack of understanding of the fundamental principles underlying the surgical treatment of cancer as well as of modern surgical technique. These failings are most evident in their discussion of cancer of the breast in which they have included a description of operative technique. Elsewhere they have wisely avoided descriptions of surgical technique.

To sum up, this is a book which is a valuable contribution from the radiotherapeutic point of view but which does not deal adequately with the surgery of cancer. It is well to keep in mind in these times when radiotherapy is being recognized somewhat belatedly as an exceedingly important part of the treatment of cancer that surgery is still by far the most important weapon against the disease.

C. D. HAASTAD

THIS newest addition to the textbooks on otolaryngology, *Diseases of the Ear, Nose and Throat*¹ deviates somewhat from the usual presentation employed by most authors and follows the established custom only in a general way. Dr. Lederer's background and association with clinicians has enabled him to correlate the subject matter and present it in a readable and entertaining full length volume of 800 pages. He has made an effort to meet the needs of general practitioners and students and also to serve teachers and specialists.

The anatomical illustrations are numerous and very well done, particularly those relating to the paranasal sinuses. A welcome addition is the chapter on diseases of the mouth and one on swellings of the neck, both subjects being well presented and accompanied by good photographs. In the chapter on correlated considerations the author calls attention to the general aspect of diseases as they relate to the ear, nose, and throat. Among others, these considerations include a differential diagnosis of headaches and the causative factors of cough.

¹CANCER, ITS DIAGNOSIS AND TREATMENT. By MAX CUTLER M.D. and FRANK BUSCHKE M.D. Assisted by SIMEON T. CANTINI M.D. Philadelphia and London: W. B. Saunders Co. 1933.

¹DISEASES OF THE EAR, NOSE AND THROAT. By FRANCIS I. LEDERER B.Sc. M.D. F.A.C.S. Philadelphia: F. A. Davis Co. 1933.

Surgical treatment is generally given in a short concise outline style useful perhaps more to the student than the practitioner. The text is on excellent paper with clear readable type. No doubt this book will find a broad use among students and practitioners alike.

JOHN F. DELPHE

THE simple aim of *Anatomie Chirurgicale du Crâne et de l'Encéphale*¹ is to present the facts of cranial anatomy in such a way as to make them readily available for their practical employment by the neurological surgeon. The authors a surgeon and an anatomist have succeeded in their purpose. The work is entirely new and while little of actually new anatomical material could be expected the general plan of the book is such that it sustains interest and makes for easy reading.

Following a plan of convenient arrangement the general anatomy of both the bony cranium and the enclosed brain is reviewed together with special descriptions of such regions as the sellar and suprasellar areas the ventricles the posterior fossa and the upper cervical foramen magnum area. In all this the presentation is not noteworthy for any es-

pecially original treatment in fact it is rather traditional with enough clinical pathology woven into the descriptions however to freshen the topic some what but it seems that the authors do not forget for a moment that their readers will be clinicians with an interest in the practical application of anatomy. The illustrations are for the most part simple drawings effective and useful but never elaborate. They are practically all originals. While the book is hardly an atlas because of the preponderance of text material and though the illustrations are not as life like or artistic as some found in other modern texts of anatomy yet the illustrations serve their purpose fully because they are placed as closely as possible to their descriptive text and thumbing through pages to a referred figure is never necessary. The treatment of the dural venous sinuses is excellent and some of the photographs of intracranial arteriographs are especially good.

This is indeed a book worth reading and owing its greatest delight lies in the directness and simplicity with which it is written. There is no padding no repetition. It is well balanced and logically arranged. The written text is free of style except for a characteristic manner of constantly but proportionately referring to the pathological state.

JOHN MARTIN

ANATOMIE CHIRURGICALE DU CRÂNE ET DE L'ENCÉPHALE. P. M. DELPHE. 116 p. 1933. By Charles C. L. and A. H. L. L. 116 p. 1933. 933

BOOKS RECEIVED

Books received are acknowledged in this department and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

PRIESTS OF LUCINA THE STORY OF OBSTETRICS. By Palmer Lindley M.D. F.A.C.S. Boston Little Brown & Co. 1939.

THE ENDOCRINE GLANDS. By Max A. Goldsacher M.D. New York and London D. Appleton Century Co. 1939.

TEXTBOOK OF PATHOLOGY A CORRELATION OF CLINICAL OBSERVATIONS AND PATHOLOGICAL FINDINGS. By Charles W. Duval M.D. and Herbert J. Schattenberg M.D. New York and London D. Appleton Century Co. 1939.

A TEXTBOOK OF SURGERY. By American Authors. Edited by Frederick Christopher B.S. M.D. F.A.C.S. 21 ed. rev. Philadelphia and London W. B. Saunders Co. 1939.

VARICOSE VEINS. By Alton Ochsner B.A. M.D. D.Sc. (Hon.) F.A.C.S. and Ho and Mahomed B.A. M.D. M.S. (Surgery) F.A.C.S. St. Louis The C.V. Mosby Co. 1939.

GYNACCOLOGY. By Herbert H. Schlunk M.B. Ch.M. (Sydney) F.R.A.C.S. Sydney and London Angus & Robertson Ltd. 1939.

MANUAL OF THE DISEASES OF THE EYE. For Students and General Practitioners. By Charles H. May M.D. 16th ed. rev. Baltimore William Wood & Co. 1939.

LA CHIRURGIE RADICALE DU CANCER DE L'ŒSOPHAGE THORACIQUE. By Michel Balivet Paris Librairie Louis Arnette 1939.

CANCER OF THE COLON AND RECTUM ITS DIAGNOSIS AND TREATMENT. By Fred W. Rankin B.A. M.A. M.D. Sc.D. F.A.C.S. and A. Stephens Graham M.D. M.S. (in Surgery) F.A.C.S. Springfield and Baltimore Charles C. Thomas 1939.

SCHOOL OF TROPICAL MEDICINE. Under the Auspices of Columbia University. Report of the Director for the Year Ending June 1938. Published by the University of Puerto Rico and Columbia University.

ÉTUDE DOCUMENTAIRE DES INDICATIONS MÉDICALES DE L'INTERFÉRENCE DE LA GROSSESSE AU COURS DES TROIS DERNIERS MOIS. By Docteur Pierre Magnin Lyon G. Patissier 1939.



treatment delivers more effective radiation about and around the cervix than can be delivered by radium alone. We feel that areas of tumor on either side of the cervix are certainly reduced in size and may be destroyed. The field of radiation in the broad ligaments and about the cervix before the radium is given is well walled off by tissue reaction and fibrosis. Therefore trauma of the cervix from cauterizing or application of radium will not cause extension of disease. Because of the roentgen dosage it is not necessary to give huge doses of radium in the cervical canal. Only when we have increased our radium over the usual dosage have we had trouble in the bladder or rectum. At the time of the first radium application which is given under an anesthetic it is usually obvious that the x ray treatment has created a great change in the cervical tumor and the broad ligaments are more fixed. There is thickening, tightening in the ligaments and the tumor is usually shrunk with occasionally nothing but a crater left in the apex of the vagina. The vaginal discharge is lessened and infection clears up. The application of radium is usually less but occasionally more difficult than it would be with the original tumor present. The weakness of our method of treatment lies in the radium plan in that masses on the vaginal walls are not given sufficient treatment. Recently we have been trying to remedy this by the use of interstitial radiation in the vaginal wall extensions given in the form of platinum needles 2 to 10 milligrams in strength with 0.5 millimeter platinum filter but not adding over 1,000 milli curie hours to the total radium treatment.

It has been possible to carry out our treatment satisfactorily by means of house officers. Because Pondville is located 20 miles from Boston it is impossible to have a visiting surgeon treat every patient, so that we have had to make the treatment as foolproof as possible. Much to our delight there have been no calamities and the results show that this form of radium treatment is safe in the hands of a surgically trained house officer.

Material. The cases used for analysis in this report are those of all types early and late that came to Pondville who were able

to take the treatment as outlined. If a patient were so feeble that after a few attempts at x ray treatment it was found we could not continue, she was not included in this series. In other words this is a relative rather than an absolute group but not a selected one. In reading the recent reports on the subject it is evident that in nearly every clinic, cases that are too far advanced are discarded and their statistics are relative. Relative statistics and not absolute ones are the more important because it is not possible to give x ray and radium treatment to all patients as some are *in extremis* and others have been treated elsewhere and should not be included.

That our relative figures are fair is shown in the type of patients treated. There were but 8 cases in the operable groups the so called A and B of the American College of Surgeons as against 62 in the advanced C and D groups. This makes it clear that cases were not picked.

Repetition of treatment. Cases with suspected recurrence of disease are occasionally treated again, usually by means of roentgen treatment but also by means of radium. This treatment is given any time after 3 months from the original radiation. It is obvious from a study of these cases that many of the re-treated patients did not have a recurrence but were found to have broad ligament thickening and were therefore given more radiation. From now on no re-treatments will be given without positive evidence of cancer. Of the cases that were re-treated in this clinic 10 have lived and 27 have died. It is our feeling that the 10 that lived had no disease and that the remainder did have disease at the time of re-treatment. Much more care should be exercised in ruling out radiation reaction because more radiation causes discomfort and frequently disaster.

Results. At the end of 5 years 5 out of 5 A cases or those with disease limited to the cervix, have survived representing a percentage of 100 of the 3 B cases or those with disease involving the cervix and vagina 100 per cent were alive after $1\frac{1}{2}$ years, 1 patient has since developed a recurrence and is called dead dropping the percentage to 66.6. Of the 45 C cases or those with disease involving

TABLE I—COMPARISON OF STATISTICS

TABLE 1—COMPARISON OF STATISTICS													
Author	Year reported	Total treated	Period treated	Living and well for 5 years								Relative cure all stages	
				A		B		C		D			
				No	Per cent	No	Per cent	No	Per cent	No	Per cent	No	Per cent
Lacassagne Institut du Radium Paris	1937	111	1930	12	75	19	56	16	34	5	35.7	52	46.8
Hurdon Marie Curie Hospital London	1937	116	1930	5	83.3	21	65.6	27	35.3	3	17.6	56	41.2
Pitts and Waterman Providence Rhode Island	1937	77	1920-1930	6	100	13	50	9	27.2	0	0.0	28	36.3
Pondville	1938	70	1931-1933	5	100	3	66.6	16	35.5	1	5.8	24	34.3
Ward and Sackett Woman's Hospital New York	1938	512	1910-1932	10	61.5	58	55.2	95	27.6	0	0.0	163	28.5
Healy and Frazell Memorial Hospital New York	1938	551	1925-1931	50	58	10	19.4	68	22.0	5	6.4	151	27.7

the cervix, vagina, and broad ligament, the percentage is exactly the same, 35.5. Of the 17 D cases, or those with complete fixation of the pelvis or remote metastases, and who are considered inoperable and hopeless, 1 survives, a percentage of 5.8. Thus the total salvage is 24 out of 70 cases, or 34.4 per cent.

COMPARISON WITH OTHER CLINICS

On comparing the results of some of the leading clinics in Europe and the United States with the Pondville series (Table I) it is interesting to note the position of Pondville. Pitts and Waterman in their last series treated by their new method, using long platinum needles of low intensity, have done slightly better than the Pondville series.

Analysis shows that the Pondville series, taken group by group, is better than that of Pitts and Waterman, but because they have so many more early cases than those in the Pondville series, their total percentage is better. This demonstrates that comparative studies ought to be made upon equal numbers per group and not total numbers of cases. In their series the A and B groups contained 28 cases and the C and D groups, 49, whereas in the Pondville series the A and B groups have only 8 cases, and the C and D groups, or advanced cases, 62 cases. Thus it is fair to say that the Pondville type of treatment is an improvement over that of Pitts and Waterman. In Europe the clinic of Lacassagne at the Institut du Radium in Paris has a good deal higher percentage of curability, and the clinic of Hurdon at the Curie Hospital in

London is next best. We recognize that the small number of cases at Pondville cannot compare with the huge series of Ward and Sackett at the Woman's Hospital and that of Healy and Frazell at the Memorial Hospital in New York. It is interesting to note in this table that the results of the early cases are about the same, except in the 2 largest series. It is also of interest to note that the 2 European clinics increase the number of their cures by better results in the more extensive lesions, especially the very extensive. Among the American clinics there is a 5.8 per cent curability of the D cases at Pondville, none at the Woman's Hospital in New York, and 6.3 per cent in the Memorial Hospital in New York, whereas Lacassagne reports 35.7 per cent, and Hurdon 17.8 per cent cured. It might be assumed that we are more particular in the choice of our cases for our extensive group, but even if Lacassagne and Hurdon were not so particular as we in the choice of that group and placed their D survivors in Group C, their C results would make our figures in that class not as satisfactory as they should be. It is therefore probable that Lacassagne and Hurdon are better able to distribute their radiation in the pelvis and about the cervix than we are with our present plan of treatment. The improvement in the Pondville series over other series that have been reported in Boston, namely, from the Massachusetts General Hospital and the Huntington Hospital, is in the C class. Cases in this group are supposed to have infiltration in the broad ligament. It is possible that what

TABLE II—FIVE YEAR END RESULTS, OPERABLE AND INOPERABLE GROUPO—“PONDVILLE TREATMENT

	Distribution by Percent	Alone Treatment	Alone Treatment
Operable			
A	5		
B	3	11	7
Inoperable			
C	45		
D	17	59	17
Total	10	100	24

has happened is that patients we felt were Class C cases with extension into the broad ligaments may have had inflammatory masses in the pelvis rather than malignant disease.

CHARTS

In comparing the present charts with those in the previous article great similarity is shown. All charts figures and statistics have been reviewed by Dr. Herbert Lombard of the Massachusetts State Department of Public Health who is responsible for the supervision of statistical papers published from the Pondville Hospital. He is satisfied that the curves in our charts are correct and believes that these charts may be used as we suggest as prognostic indicators. He considers this an extremely important contribution. In Chart 1 it will be noted that the curve starts from the onset of the disease. This is reckoned for each patient as 8 months as that was the average time of onset in all cases. To obtain the average duration of symptoms the total number of months of symptoms of all 70 cases were added together and the total divided by 70. In a large series of cases this may be considered accurate. Considering the onset in all cases with disease 8 months before treatment Chart 1 comes on from the onset to $5\frac{1}{2}$ years later. It will be noted that at the end of 3 years the curves are practically parallel. The curve of the un-

TABLE III—FIVE YEAR RESULTS IN EARLY CASES—BOTH METHODS OF RADIATION GIVE BETTER RESULTS THAN SURGERY

	Percent
Pondville (x ray and radium)	87.5
Massachusetts General Hospital (radium)	64.3
Massachusetts General Hospital (surgery)	46.1

TABLE IV—COMPARISON OF FIVE YEAR RESULTS—RADIATED CASES

Crops	Fertilizer			Manure		
	No.	%	Percent	No.	lbs. per acre	Percent
A	5	5	100.0	15	12	80.0
B	3	2	66.6	13	6	46.1
C	45	16	35.5	102	16	15.6
D	17	1	5.8	20	0	0.0
Total	70	24	34.3	150	34	22.6

The results of the Pondville series are compared by classes with the Massachusetts General Hospital series. Pondville has improved the results in all classes.

treated patients ends at death at $5\frac{1}{2}$ years but the other 2 curves representing a huge series of cases from Pondville and from the Huntington Memorial Hospital and the combined cases from the Massachusetts General Hospital and Pondville, show only a very slight variation from one another from $2\frac{1}{2}$ to $5\frac{1}{2}$ years. It appears as though there was not going to be a sudden drop. Each curve falls about 15 per cent in the last 2 years. In other words if we follow our cases for 3 years from onset of disease and then subtract 15 per cent for the next 2 years, we can predict the percentage alive at the end of that time.

Chart 2 shows the same series but now the group of cases from Pondville and the Massachusetts General Hospital are separated. Here again it is evident that there is a very slow but regular decrease of cases from the 3 year interval until $5\frac{1}{2}$ years are reached. The curves do not drop suddenly, they decline gradually, almost perfectly parallel. This must mean that the end results can be predicted after 3 years have passed from the onset.

Chart 3 is very important for it includes a series of radium treated cases from the Massachusetts General Hospital which were followed for 8 years after treatment and a similar

TABLE V—DISTRIBUTION OF CASES

	Class A	Class B	Class C	Class D
	No.	Percent	No.	Percent
Pondville (x ray and radium)	8	11	62	89
Massachusetts General Hospital (radium)	23	19	122	81
Massachusetts General Hospital (surgical)	39	65	21	35

In this table it can be readily seen that the types of patients in the Pondville series were more advanced than those seen at the Massachusetts General Hospital for early cases and more advanced ones.

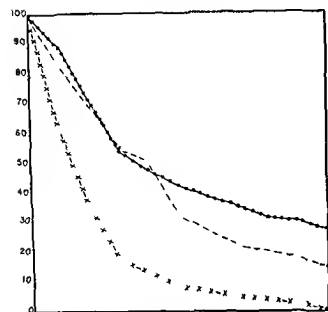


Chart 1 This chart shows a series of cases plotted against a series of untreated carcinomas of the cervix. The same general trend is obvious. After 3 years the 2 treated series & a very large group treated with radiation by various surgeons and the other a group treated by the same surgeons at the Massachusetts General Hospital and Pondville Hospital show the same general trend. M G H radium and Pondville combined 220 cases treated (Welch and Nathanson) 2192 cases x x x untreated (Welch and Nathanson) 67 cases

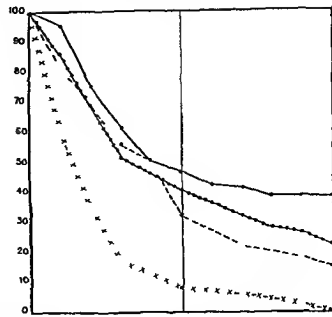


Chart 2 In this chart the Massachusetts General Hospital and Pondville Hospital series have been separated. Beginning at 3 years the same slow downward trend is evident. M G H radium 150 cases Pondville 70 cases x x x untreated (Welch and Nathanson) 67 cases treated (Welch and Nathanson) 2192 cases

but larger series from the Radiumhemmet. Included in this chart, to show how closely all curves parallel, are the Pondville cases and the larger Massachusetts General Hospital series. The 2 longer series starting at $3\frac{1}{2}$ years after treatment are nearly parallel for the next $4\frac{1}{2}$ years. There is no sudden decrease and the deaths, in most instances classified as cancer deaths, are not greater than the fall of the life expectancy curve at this age. It is more than probable that most deaths in the later years were due to causes other than cancer. The group from Pondville and the Massachusetts General Hospital followed but 5 years have the same general trend and from our experience will continue to diminish less than 2 per cent per year for the next 3 years. It is the feeling of the authors that this group of curves definitely refutes the suggestion that radium treated cases are not as sure of permanent cure as surgically treated ones.

Chart 4 in another and perhaps more graphic manner tells the same story. The groups discussed under Chart 4 are tabulated

in graph form. The first 2 years are obviously the serious years for patients with cancer of the cervix for in the third and fourth years, respectively, less than 9 per cent of the total number of cases, not including the survivors, died. In the fifth year not over 5 per cent died, and in the sixth, seventh, and eighth years not over 2 per cent. Thus it is evident from these various charts that end results in a series of cases of cancer of the cervix treated by radium or radium and x ray can be predicted by subtracting 10 per cent of the total number for the third year, 10 per cent for the fourth year, and 5 per cent for the fifth year, and results up to the eighth year by subtracting 2 per cent for each of the next 3 years. This should be of great value. Thus if at the end of the second year in a group of 100 patients 54 per cent are alive, 10 per cent may be subtracted for each of the next 2 years, leaving 34 per cent, and for the fifth year 5 per cent, leaving 29 per cent of predicted 5 year survivors. Thus final results will be within a 5 per cent error. Such mathematical maneuvers are of enormous value for the therapist can satisfy himself of his expected results after a follow up of 2 years,

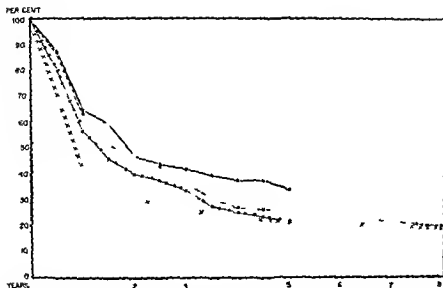


Chart 3 This chart shows that 2 years after treatment there is a very slow decrease to per cent or less from the second to the third year 10 per cent from the third to the fourth year and 5 per cent from the fourth to the fifth year After that not more than a 2 per cent fall occurs There is no sudden drop and the fall is not more than the life expectancy for the given age groups In the first and second years most of the deaths occur This is probably due to the extent of the disease and not to the type of radiation ——— Pondville 70 cases - - - - - M G H 100 cases x x x x Radiumhemmet 674 cases (1923-1927)

and certainly after a follow up of 3 years. It is obvious that most of the deaths occur in the first 2 years and we are now coming to believe that most patients who have no obvious disease at the end of 2 years have a good chance for recovery.

What is the importance of these observations? That it is only necessary to follow our cases for 3 years following treatment and then by deducting 15 per cent the 5 year end results can be predicted. Therefore it is unnecessary to wait for 5 years following treatment before reporting a group of cases or to change a method of treatment. In each radiotherapist's life if he waits 5 years before making a report or changing a plan of treatment, there will be few opportunities to study a new series because it takes 2 years or more to obtain a large enough series of cases to report. Then by waiting 5 years for the end results makes about 7 years in all. Thus in 28 years 4 series followed for 5 years could be reported and only 4 changes of treatment based on accurate figures could be made. By being able to predict the end

result at the end of 3 years from the time of treatment it will be possible to attempt more methods of management of cancer of the cervix based on satisfactorily followed up cases. We feel that the observations from this study may make a great deal of difference in future reports of the results of treatment of cancer of the cervix.

Chart 5 is also of importance. In our previous paper we compared the total number of surgical cases directly with the total number of irradiated cases at Pondville and the Massachusetts General Hospital and the comparison was not in favor of radiation but more in favor of surgery. This comparison was not fair for the surgical cases were those that could be operated upon or in whom an attempt was made to operate. In other words, they were the operable or early cases. In this present study the surgical cases were carefully sorted out and all cases with broad ligament extension discarded so as to place the surgical cases in the A and B groups of the American College of Surgeons comparable to the A and B groups who were treated with

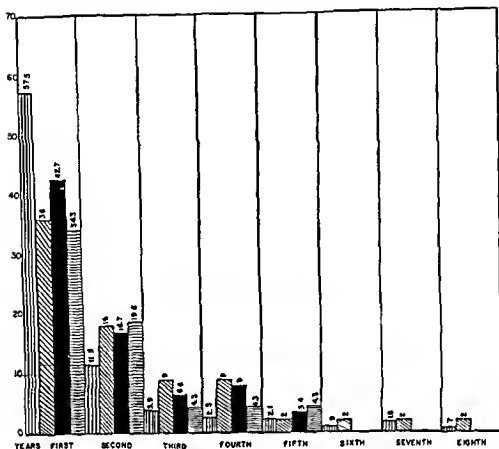


Chart 4. This chart shows by another method the percentage of deaths of the total number of cases for each year. Notice that not over 10 per cent die in the third and fourth years while in the fifth only 5 per cent succumb, and in the remaining years not over 2 per cent per year. Vertical lines Radiumhemmet 674 cases oblique M G H 100 solid black M G H radium 150 horizontal Pondville 70

radium. The results are plotted on a chart for 5 years and it is evident that surgical cases do not do as well as the radiated ones. In the Pondville series of 8 cases, a very sharp drop in the curve occurs between the fourth and the fifth years, one patient dying in that time. In the Massachusetts General Hospital's radiated cases a very slow fall occurs, 64.2 per cent of the cases in that series living at the end of 5 years. The Massachusetts General Hospital's surgical group, operated upon by Dr. Lincoln Davis and Dr. Farrar Cobb and reported some years ago, shows that there are but 47 per cent alive and well at the end of 5 years. These groups are as comparable as they can be made. This observation answers for us the question of whether or not we ought to operate upon cancers of the cervix. Until we can be sure that the curve of patients operated upon is the same or better than that of the patients treated with radiation we will

not feel inclined to operate upon them. The operations done by Dr. Cobb and Dr. Davis were radical operations, not true Wertheim operations, but a modified Wertheim, a great deal more extensive than hysterectomies that one sees performed in this country today. We believe that they were more radical than most modern operators and that their patients died faster than did the patients given radiation, even excluding the surgical deaths.

PATHOLOGY

It was the plan of Meigs and Dresser that all Pondville patients have biopsies taken from the cervix throughout the treatment. A biopsy is taken before x-ray treatment is started, 1 at the conclusion of the x-ray treatment at the time of the first radium treatment, 1 at the time of the second radium treatment, and 1 before discharge from the hospital. In most cases we have 4 biopsies

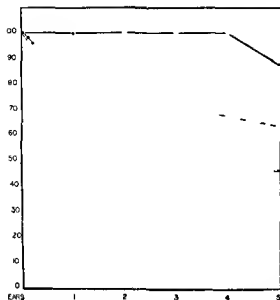


Chart 5 This chart graphically demonstrates that the fall of cases in comparable groups A and B is greater in the group operated upon than in the group treated with radiation. This chart is important to consider before deciding that surgery is better in early cases. A and B cases only. M G H surgical 39 cases M G H radium 28 cases ——— Pondville 8 cases

from the cervical tumor and from the microscopical study of this material important conclusions have been drawn. It is our policy in the Out Patient Follow up Clinic to have all slides of the biopsies of each patient looked at when the patient is examined. It is the opinion of the authors that if a satisfactory radiation response or reaction is found microscopically in a case not too far advanced that a fairly good prognosis can be given the patient. If the reaction is not satisfactory and if at the end of the radium treatment un-injured or unchanged cancer tissue is still seen it is felt that the prognosis is poor.

The microscopical slides of these cases have been studied recently by both the authors and by Dr Shields Warren and Dr A O Severance of the Department of Pathology at the Pondville Hospital. Detailed findings will be presented in a succeeding paper but a few of them are pertinent at present. It is well to state at the beginning that in the review of all the slides in this series the pathologists described radiation reaction microscopically in 2 cases before the patient

had had any treatment therefore the microscopical diagnosis of radiation reaction, as evidenced by vacuolization of cells prominence of the cell membrane, pyknosis of nuclei, abnormal mitotic figures abnormal nuclei, fibrosis change in blood vessel walls and change in connective tissue stroma is not 100 per cent accurate. Of 10 patients showing no radiation reaction in the epithelial portion of the tumor after x ray treatment was completed only 1, or 10 per cent, is living. Of 5 of the same 10 patients still showing no radiation reaction after both the x ray and radium were given none are living. Of 12 showing no radiation reaction in the stroma after x ray treatment only 2, or 16 per cent, are living, and of 7 of the above 12 patients showing no radiation reaction in the stroma after both x ray and radium none are living. Six patients with no reaction in either stroma or epithelium are dead. This finding is extremely important and bears out the observations made from the slides in the Follow up Clinic. If radiation reaction is present and persists through the various biopsies a fairly good prognosis can be hoped for. If no reaction is present, or if there is actively growing cancer without reaction anywhere on the slides the outlook is poor. The results show that no radiation reaction after x ray alone means a poor prognosis whether the reaction is judged by the epithelial part of the tumor or the stroma. Those showing no effect on the tumor after radium was given are all dead.

The cases were divided into the following grades there was 1 grade I or slowly growing type of cancer. This patient was in class C or the advanced group, and she is dead. Twenty-five or 35.7 per cent of the patients were classed as grade II or the medium grade tumor. Four of these 25 patients or 16 per cent were in the favorable group classes A and B and all are well. Twenty-one, or 84 per cent were in classes C and D the most unfavorable groups and 7 of the 21 or 33 per cent, are living and well. Thirty-two or 45.7 per cent were grade III or the rapidly growing type. Only 2 or 6.2 per cent of these 32 cases fell into the early or favorable class 1 is dead and 1 is living and well. Thirty of the 32 patients in the grade III

group, or 93.8 per cent, were in the C and D or unfavorable class, 8 of these 30, or 26.6 per cent, are living and well. There were 3 adenocarcinomas and 2 are well. One with carcinoma simplex is dead. The best results are in grade II, or those with medium grade malignancy, with 12 of 25 cases living and well in all groups.

METASTASES

In this series there were numerous metastases. One patient had metastases in the groin, this is a rather rare region to which malignant disease of the cervix will metastasize, but it is possible when the tumor is low in the vagina. One had metastases to the peritoneum, liver, and kidneys, and 2 metastasized to the lungs. There were patients who had metastatic cancer in the sacrum, coccyx, pelvis, ilium, ischium, and pubis. Four patients had extensive disease in the pelvis. The tumor apparently extended directly from the cervix or the pericervical regions. This extension may occur along the perineural lymphatics, as Warren, Harris, and Graves showed that it does in carcinoma of the prostate. It is possible that further autopsy studies will show that carcinoma of the cervix extends into bone exactly as prostatic cancer does.

OTHER FINDINGS

Weight loss seems to be important, of 26 patients with a definite loss only 6 are living and 20 are dead. Of 15 patients with severe pain at the time of the radiation treatment 3 are living and 12 are dead. Twenty-seven had reached the menopause, 11 of these patients are living and 16 are dead. Fifty-seven had regular menstrual periods, 21 of whom are living and 36 are dead. A figure of very little consequence. There were 21 patients with a family history of cancer, of these 4 are living and 8 are dead. Nine patients, or 12 per cent, had no children. This figure is about the same in all statistics, that is, about 10 to 15 per cent of patients have not had cervical lacerations or pregnancy hormone changes. Five patients had positive Wassermann reactions, 4 are living and 1 is dead. Routine Wassermann tests were done in all cases. A positive Wassermann is of little significance.

One of the most important findings in this series is the significance of the first examination 3 months after the patient's discharge from the hospital. If tumor was present, the prognosis was poor. In this series 36 patients showed disease at the first examination and of this group only 3 are living and 33 are dead. This again suggests that patients with cancer of the cervix die soon following treatment, also that if the first radiation does not check the growth there is very little hope that further treatment will do so. Therefore, we believe that the first examination is extremely important and is of great prognostic significance. If cancer is present, the patient will not recover, and if there is no cancer, recovery can be expected.

The tolerance to treatment and the general response of the patients have no prognostic significance, but local response of the tumor as far as the change in gross appearance is concerned is important. The local response was poor in 21 patients and only 1 is living and 20 are dead. But when the local response was good, as it was in 29 patients, 20 lived and only 9 died.

RENAL LESIONS

One of the most important findings made during this study is to be reported in detail later by Dr. Jaffe, Dr. Meigs, Dr. Graves, and Dr. Kickham. It is a report concerning the renal and ureteral lesions following and during treatment of cancer of the cervix. It is our opinion that by more intelligent management of ureteral obstruction, hydronephrosis, etc., we may be able to produce better end results from the radiation treatment of cervical cancer than we have at the present time. We feel sure that many patients died unnecessarily from renal infections and uremia, who did not die because the growing tumor shut off the ureters but rather because changes in the tumor due to radiation or fibrosis of the pelvic connective tissue shut off the ureters and produced mortal lesions in the kidneys. It is our plan to consider and study the renal condition in more detail than ever before, to investigate the patients before they are given any radiation, during radiation, during the radium treatment, and before and after dis-

charge from the hospital. Thus we hope to find early lesions and treat them properly either by dilatation of the ureter or by nephrostomy. There is no doubt that most cases of cancer of the cervix die of uremia. In this series 25 of the patients had proven ureteral obstruction, and of that group all but 2 are dead and these 2 had intelligent urological treatment. Not all the patients had carcinoma blocking the ureters because some autopsies showed fibrosis around the ureter rather than gross cancer. Unfortunately most ureters were not examined microscopically to rule out tumor but gross tumor was not present. It is probable that our treatment is producing changes in the pelvic connective tissue that may interfere with the ureter. It has been the contention of one of us (J.V.M.) that some of the swollen legs seen following treatment 1 to 5 years later are not due to advanced disease but to pelvic fibrosis with involvement of lymphatics and veins. It has been our experience to subject to radiation patients with swollen legs because malignant infiltration was considered the cause. It is quite possible that the swollen leg is due to fibrosis in the pelvis which shuts down the return supply of lymph and venous blood. At some time in the patient's life following treatment perhaps during some illness or some infection when it is necessary to take to bed the slowed up blood stream allows thrombosis to occur and phlebitis and edema follow. Further investigation is now being carried out along these lines. By watching our patients more carefully and by obtaining more material from autopsies we may be able to discover as far as the genito urinary tract and pelvis are concerned whether our radiation treatment as given now is causing too much fibrosis.

SUMMARY AND CONCLUSIONS

This paper presents 70 patients who have been followed and studied very carefully. It shows that the results of the treatment of cancer of the cervix with x-ray and radium are eminently satisfactory. It is evident that certain charts of prognostic value can be made and the curves induce the authors to believe that it is no longer necessary to follow patients

for 5 years before reporting on them but that a 3 year follow up from the time of treatment should suffice. If from the end results at 3 years 15 per cent is deducted for the next 2 years the approximate 5 year results can be predicted. Therefore more opportunities are given to the gynecologist and radiologist to change a given form of treatment.

We believe that the routine study of microscopical slides while the patient is being seen is of great value. The presence or absence of a proper microscopical radiation reaction is an important prognostic sign. The authors advise that in every cancer clinic the slides be looked at at the same time that the patients are examined.

Biopsies should be taken before treatment starts and after treatment to determine whether or not radiation is satisfactory as determined by the radiation reaction.

In this series of cases it is evident that kidney lesions due to blocked ureters with subsequent uremia are among the chief causes of death. It is the feeling of the Pondville Staff that more urological investigation should be undertaken and it should be undertaken before during and following treatment. Any indication of ureteral block should be treated early rather than late.

REFERENCES

1. BERNY, I. and HEYMAN, J. Ca. treated at Radiumhemmet in Stockholm 1921-1937 and controlled 1921-1937. *Cancerforeningen's Stockholm* 1937 p. 47.
2. CRAVES, K. C. WARREN, S. and HARRIS, P. V. Chemos metastases of carcinoma of prostate etc. *Tr. Am. Ass. Genito-Urin. Surg.* 1936, 20, 170.
3. HEALY, W. P. and FRAZELL, P. I. Methods and results of treatment in carcinoma of the cervix. *Am. J. Obst. & Gynec.* 1937, 34, 593.
4. HURDON, ELIZABETH. Cancer of the cervix uteri. Annual report on the results of radiotherapy in cancer of the cervix. League of Nations Health Organization C. H. 1225 July 1937 p. 41.
5. LACASSAGNE, A. Cancer of the cervix uteri. Annual report on the results of radiotherapy in cancer of the cervix. League of Nations Health Organization C. H. 1225 July 1937 p. 55.
6. LYNCH, FRANK W. Personal communication.
7. MILES, JOSEPH and DRESSER, RICHARD. Carcinoma of the cervix treated by the roentgen ray and radium. *Ann. Surg.* 1937, 106, 653.
8. LITTS, HERMAN C. and WALKERMAN, GEORGE B. The treatment of cancer of the cervix uteri at the Rhode Island Hospital. *Surg. Gynec. & Obst.* 1937, 64, 30.
9. WARD, C. C. and SACKETT, N. B. Results of radiation therapy for carcinoma of the uterus. *J. Am. Med. Ass.* 1938, 110, 523.

PATHOLOGICAL FEATURES OF SOFT TISSUE FIBROSARCOMA

With Special Reference to the Grading of Its Malignancy

ALBERT C BRODERS, M D, Rochester, Minnesota

ROBERT HARGRAVE, M D, Wichita Falls, Texas, and

HENRY W MEYERDING, M D, F A C S, Rochester, Minnesota

IN a recent publication (Meyerding, Broders, and Hargrave), we discussed the general etiological factors, clinical features, prognosis, and treatment of fibrosarcomas of the soft tissues of the extremities on the basis of a study of tumors from 152 patients. It is the object of this paper to present in greater detail their pathological features and to describe from a histopathological standpoint the different types of fibrosarcoma with special reference to the grading of their malignancy.

NOMENCLATURE

The gross and microscopic structures of fibrosarcomas recall the older terminology. These growths comprise the "fibroplastic tumors" of Lebert and Birkett, the "recurrent fibroids" of Paget, the "fasciculated sarcomas" of Cornil and Ranvier and the "fibronucleated tumors" of Bennett. Lancereaux, Billroth, and Virchow employed the terms "spindle cell sarcoma" or "fibrosarcoma." The terms "neurogenic sarcoma," "neurosarcoma" and "neurofibrosarcoma" have been widely used to designate not only certain tumors showing definite nerve connections but also tumors of a similar architecture in which a nerve genesis has been presumed (Ewing, 24, 25, Bick, 4-6, Geschickter, 31, Fox, Simmons). Recently there has been a tendency for certain authors to assign as neurogenic practically all tumors which previously had been called fibrosarcoma and spindle cell sarcoma (Quick and Cutler, Stewart and Copeland, Hertzler, Ryan and Camero). Less than a third of the patients,

however, present significant nerve symptoms, characterized by radiating pain, paresthesia or paralysis, and in only about 10 to 15 per cent of the total number can definite nerve connections be demonstrated. In somewhat over half of these tumors the structure is that of a compact cellular spindle cell sarcoma and is identical with the structure of many sarcomas which develop within nerve trunks and in the tumors of von Recklinghausen's disease. It is debatable, however, whether this structure is specific for nerve tumors, for many growths of exactly the same architecture neither produce pain nor show nerve connections. We, therefore, do not employ the neurogenic terminology here but designate all the tumors as fibrosarcoma.

In a subsequent paper we propose to discuss the genesis of these tumors.

TOPOGRAPHIC DISTRIBUTION

Of 148 primary, solitary fibrosarcomas, 51 occurred in the upper and 97 in the lower extremities. In 4 patients the tumors were multiple. Three of these presented tumors in both the upper and lower extremities, while 1 exhibited tumors in both lower extremities. The flexor portions of both the upper and lower extremities were much more frequently involved than the extensor. Of the total number of tumors 43.4 per cent were situated in the region of the thigh and knee.

There were 102 male and 50 female patients. The average age at the time of registration at The Mayo Clinic, for the entire group, was 43.2 years.

GROSS ANATOMICAL FEATURES

Fibrosarcomas begin in their earliest recognizable form as small, hard, circumscribed

Section on General Pathology The Mayo Clinic Rochester Minnesota

Section on Orthopedic Surgery The Mayo Clinic Rochester Minnesota

movable tumors beneath the skin. Occasionally those arising in the deeper structures may attain considerable dimensions before their presence is noticed. In certain tumors which develop after trauma the post traumatic edema may coincide with the swelling produced by the growing tumor and mask the true nature of the process. In 9 instances the sarcoma became manifest as a result of active growth of an apparently benign nodule of many years duration.

In 6 of the 12 patients the tumors arose in the subcutaneous fat and loose fibrous tissue. In 3 patients the tumors apparently originated in the deep layers of the skin. In the remainder the tumors developed in the deep tissues either in the loose intermuscular fat and fibrous tissue along the course of important vessels and nerves or in such positions as to be intimately associated with the deep fasciae, intermuscular septa, muscles, muscle sheaths or parosteal areolar tissue. In 16 patients the tumors were attached to important nerves or their sheaths. Of these the brachial plexus was involved four times, the ulnar once, the median twice, the sciatic four times, one or both popliteals four times and the femoral cutaneous once. One patient presented an intraneural tumor of the external popliteal. In 5 additional instances the tumors were in close proximity to important nerves and may or may not have been actually attached to them. These nerves were the ulnar, median, radial, internal popliteal and peroneal.

Grossly, these tumors are rounded or lobulated and more than half are encapsulated. Those not encapsulated are usually exceedingly well circumscribed. In only 4 primary and 5 recurrent tumors did gross infiltration of the neighboring tissues occur. The capsule in many cases completely invests the growth and may be quite delicate or extremely thick and fibrous. In other instances the tumor may appear only partly encapsulated as the result of adhesion, usually in one but occasionally in more than one place, to surrounding fascia or muscle bellies. The capsule is loosely attached to the surrounding soft parts but rather firmly united with the tumor by penetrating fasciculi of tumor tissue. These features ac-

count for the ease with which such sarcomas in most instances, can be shelled out with their capsules from the neighboring structures. However, in unusual instances, the tumors may be so firmly united to the surrounding parts as to render their removal by excision technically impossible.

Their texture may be hard and fibrous or soft and friable depending on the amount of fibrous tissue which they contain. In accordance with this, the cut surface may exhibit bundles of fibrous tissue running in various planes similar to those seen in certain fibromyomas, or may be extremely soft and homogeneous. All transitions are found between these two types. Gelatinous regions may be present in places, or to such an extent as to call for the designation of "myxosarcoma." Edema as the result of venous occlusion or stasis occasionally involves the tumor in foci or as a whole and may give rise to pseudomyomatous changes (Coureaud, Daiger, and Seguy) similar to those observed in certain liposarcomas (Jaffe). In many so called myxosarcomas the texture is produced by simple edema. For positive reactions for mucus are not always obtained with thionine and mucicarmine.

Cystic areas are sometimes encountered especially in very cellular spindle cell tumors. These cysts may be large or small and frequently show delicate trabeculae traversing their diameters. Necrosis from infarction and areas of hemorrhage, both old and new as a result of rupture of fragile vessels are frequently found in rapidly growing tumors. Areas of calcification demonstrated roentgenologically or by the gross or microscopic examination of the tumors were present in 11 cases. Ossification of the stroma of spindle cell sarcomas has been described by Butlin, Hutchinson and Jarda and it occurred in 2 of our cases (Fig. 1).

FEATURES OF TUMOR GROWTH AND METASTASES

The growth may be rapid or slow depending on the cellular structure of the tumor. Even though frequently encapsulated these tumors possess a remarkable capacity for invasion of the surrounding structures which is brought about after penetration of their cap-

sules Practically all tumors which attain sufficient size become densely adherent, in one or more places, to the surrounding fasciae and muscle tissue Occasionally they grow in such a way as to surround completely important vessels and nerves, incasing them within solid tumor masses, and they may produce marked swelling and induration of the parts as a result of venous occlusion Periosteal reaction with erosion of the bone cortex may result from irritation of the tumor, while occasionally bone atrophy occurs from pressure These features were demonstrated in 9 instances Actual bone invasion with destruction of the cortex and medulla was present in 19 cases (Fig 2) Occasionally, rapidly growing tumors protrude through the sites of operative incisions, producing large infected mushroom like growths Tumor fungi may likewise result after destruction of the skin with cancer pastes or may, in unusual instances, occur spontaneously

Following simple excision the tumors practically always recur Recurrent tumors may be either single or multiple and are usually located in the region of the previous operative incision They, like the primary growths, are nearly always encapsulated or sharply delimited, except at points of adherence to the neighboring soft parts Following amputation, stump involvement frequently occurs We have found little to support the view, presented by Stewart and Copeland, that stump recurrences represent new, primary tumors developing higher up along the nerve trunks

After repeated recurrences the patients die of visceral metastases or from sepsis or hemorrhage as a result of ulcerating tumors Pulmonary metastasis is by far the most frequent cause of death and of 104 patients who died as the result of the sarcoma 60 are known to have developed pulmonary involvement In all probability many other patients developed this condition but our knowledge does not permit definite conclusions to be made on this point Regional lymph nodes were involved in 5 patients, in 2 of whom the primary tumor was in the upper and in 3 in the lower extremity Intra abdominal and hepatic metastases were present in 15 cases, in 13 of which

the primary tumor was in the lower extremity In 9 cases the sarcoma terminated the life of the patient by widespread visceral cutaneous, and osseous metastases

The duration of the disease in fatal cases varies considerably and depends on the type, degree of malignancy, and location of the tumor, the natural resistance and age of the patient, and the diligence with which treatment is instituted Rapidly growing and metastasizing tumors may prove fatal within 6 to 8 months after their apparent onset, while in protracted cases the patients may succumb to the sarcoma as long as 20 or more years after its manifestation One patient in the present series, whose case has been previously reported by one of us (Meyerding 44), died from pulmonary metastasis 22 years after the onset of the disease and after an 11 year clinical cure following amputation, while another patient died from pulmonary metastasis 23 years and 3 months after the onset of the tumor and 3 months after excision of the eighth local recurrence

MICROSCOPIC STRUCTURE AND HISTOLOGIC TYPES

These tumors are composed of fibers and cells built on a scaffolding of minute blood vessels The system of growth varies considerably in different tumors Some present a fasciculated pattern produced by bands of parallel fibers and cells traversing various planes, while others display an intertwining arrangement of the component parts

The periphery of the growth is usually sharply demarcated and the capsule, if present, comprises a tunic of connective tissue closely applied to the tumor cells The capsule shows numerous points of penetration by fasciculi of tumor cells growing out obliquely In tumors that infiltrate the surrounding tissues, the advancing margin of the process is frequently preceded by a protective barrier of fibrous tissue, the older parts of which become absorbed in the recently formed neoplastic tissue as the growth progresses

Incorporated muscle, blood vessels, and nerves may be found within the tumor In cases of muscle invasion an inflammatory reaction usually precedes the advancing

growth. Actual invasion is accompanied by fragmentation and atrophy of the muscle fibers and is occasionally associated with a multiplication of the muscle nuclei. No evidence was found to substantiate the view presented by Sokolow, Iupinami (29) and Iredingham that the muscle elements are sometimes actually transformed into sarcoma cells.

The supporting stroma is composed of delicate fibers radiating from small vessels many of which are extremely fragile and composed of a single layer of endothelium. Frequently tumor cells come directly in contact with the blood current and occasionally they line vascular spaces for a considerable distance. On a few occasions we have observed tumor thrombi within the intrasarcomatous and capsular vessels. These features afford ample opportunity for malignant elements to be swept into the circulation and explain the frequency of pulmonary metastasis. The freedom from involvement of the lymph nodes although by no means universal is due both to the absence or scarcity of lymphatics within the tumor and to the infrequency of secondary lymph vessel invasion determined by the expansive rather than infiltrative nature of the growth process and the protection afforded by the enveloping capsule.

The cellular elements resemble fusiform fibroblasts and may consist of either large or small cells intermingled or in almost pure form. For the most part three rather distinct varieties may be distinguished namely fibrogenic sarcoma, cellular spindle cell sarcoma and myxosarcoma. Table I shows the anatomical distribution of these tumors.

The structure of fibrogenic sarcoma is rather specific. The individual cellular elements are fusiform, may vary considerably in size, are not closely packed and are separated by strands or bundles of collagen fibrils. All gradations are found between very fibrous growths which closely approach benign fibromas, and highly malignant tumors. In the fibrous tumors of low malignancy (Figs 3 and 4) the cellular elements closely resemble fibroblasts and show a moderate degree of variation in size and form. The nuclei are oval and may be slightly lobulated or spindle shaped. The nuclear chro-

matin forms a rather delicate reticular network, the whole structure appearing usually not very chromatic. One or more prominent basophilic or achromatic nucleoli are frequently present. The cytoplasm is abundant, acidophilic, and drawn out into long processes at the ends of the cells. In this type of tumor cellular division occurs by mitosis and is not very prolific. As the tumor ascends in the scale of malignancy (Figs 5, 6, and 7) many of the cells take on unusual growth capacities so that very large and much smaller cells are present in the same tumor. Both the cytoplasmic and nuclear volumes are increased. There is a definite increase in the amount of nuclear chromatin and multiple large granules may be present. Large long spindle cells with abundant acidophilic cytoplasm appear. Gigantic cells with lobulated and multiple nuclei may be produced as a result of nuclear budding. Atypical and multiple mitoses are frequent. The cytoplasm of some of the cells may show vacuolization or albuminoid granules as a result of degeneration. Scattered about are smaller spindle cells of various sizes with small amounts of cytoplasm and oval or spindle shaped dark staining nuclei, similar to those seen in cellular spindle cell sarcoma. Everywhere the cells are separated by delicate strands of collagenous fibrils. In some of the more malignant tumors the amount of collagen may be considerably reduced yet the fibrogenic capacity of the tumor is retained. In this particular type of sarcoma the fibroblasts seem to be stimulated along greatly exaggerated normal lines of growth and function.

In cellular spindle cell tumors the individual elements more nearly approach a uniform size and are densely packed. There is little intercellular substance (Figs 8, 9 and 10). The cells in different tumors vary in size and shape but those in a given growth except for slight variations, usually appear quite identical. The cells may be smaller about the same size or considerably larger than those seen in the fibrogenic tumors of low malignancy. They are spindle shaped and the cytoplasm, which is extremely scanty, is drawn out into delicate end processes along the long axis of the cell. The nuclei are

plump or slender, and fusiform, and usually show pointed but sometimes blunt ends. The chromatin granules are coarse, the nuclei appearing compact and much more chromatic than those of fibrogenic sarcoma. One or more minute basophilic nucleoli may or may not be present. Nucleoli are practically never prominent features in this particular type of tumor. Cellular division occurs indirectly and is uniform. Large cells and tumor giant cells are never conspicuous features. The cells are separated by a network of reticulin fibers which make up the loose intercellular substance. Some tumors show practically no collagen fibrils except the supporting stroma of blood vessels while in other instances a few intercellular collagen fibrils are present. The more malignant fibrogenic tumors appear much more formidable under the microscope than do spindle cell growths of an equal degree of malignancy.

Transition forms between cellular spindle cell tumors and certain fibrogenic tumors are occasionally found. These are composed of long spindle shaped cells or what, with ordinary stains, appear to be branching cells arranged loosely in interlacing fasciculi. The nuclei resemble those seen in cellular spindle-cell tumors. The cellular elements are separated by microcystic spaces and by fine reticulin fibers and perhaps a few wavy collagenous fibrils (Fig. 11). In other tumors of the same type, collagen production is well developed producing a form of low grade fibrogenic sarcoma. Tumors of this series comprise the so called neurogenic sarcomas.

Whether genuine myxosarcoma is a variant of fibrosarcoma is uncertain. Many myxosarcomas can be more closely traced to fat cells, for all variations are found between liposarcoma and pure myxosarcoma (Ewing). Many cellular spindle cell tumors show areas of loose structure composed of stellate or spindle cells separated by a considerable quantity of myxomatous or pseudomyxomatous tissue (Fig. 12). A few fibrogenic tumors show similar features. There may be considerable variation between the structure of primary and recurrent fibrogenic or spindle cell tumors in regard to the amount of myxomatous or pseudomyxomatous tissue present. The cytoplasm

of the cells may be very scanty or quite visible and drawn out into one or several processes. In some myxosarcomas the nuclei closely approach those seen in small spindle cell sarcoma, while in other instances the nuclei are more vesicular, oval or lobulated, are not very chromatic, and resemble the nuclei in fibrogenic tumors (Fig. 13).

Speculations as to the nature of myxosarcomas, although interesting, are not very practical. The practical aspect of the subject, we have shown, is in regard to their degree of malignancy. Their malignancy may be accurately determined by the rules set down for fibrogenic sarcoma.

A small but not well defined group of tumors have certain distinguishing features both clinically and microscopically. These tumors are highly malignant, run a very rapid course, and prove fatal early. Grossly, they are soft in texture and often show areas of necrosis. Their structure is very cellular and composed of plump, spindle shaped, or polyhedral cells, often with abundant acidophilic cytoplasm and very little intercellular substance (Fig. 14). There is usually only slight variation in the individual cellular elements, however, tumor giant cells may be quite numerous. The nuclei are very hyperchromatic and prominent nucleoli may be a conspicuous feature. Tumors of this nature probably represent highly malignant, undifferentiated fibrogenic or spindle cell tumors. They, however, cannot with clarity be identified with either of these forms.

A peculiar morphological feature present in certain spindle cell and anaplastic cellular tumors is a perivascular arrangement of the tumor cells. These tumors comprise the so called peritheliomas (Borrmann, Zeit, Ewing), which derive their name from the probably hypothetic perithelium, a membrane, described by Eberth, ensheathing the small vessels of the pia mater, and later declared to be present about the blood vessels of the adrenal, pituitary gland, breast, and salivary glands (Zeit).

The structure is typical and consists of medium sized arterioles surrounded by a heavy mantle of tumor cells, while the intervening parts are composed of loose myxoma-

tous tissue (Figs 15 and 16) A secondary penetheliomatous picture may be the result of massive necrosis of all the cells except those immediately surrounding the blood vessels. Some carcinomas present a similar architecture hence a penetheliomatous structure has no histogenetic significance. The particular pattern is apparently determined by the relatively large caliber of the supplying arterioles the rapidly growing cells using them for a scaffolding and for nourishment. These penetheliomas although closely related, are somewhat different in structure and can usually be distinguished from penetheliomatous angiosarcomas and endotheliomas.

There were 7 examples of perivascular fibrosarcoma among the cases studied, 3 of which were clearly the result of intervascular necrosis, 1 occurred in the thigh and 2 each in the buttock, elbow region and forearm. All were highly malignant tumors and there was but one cure, the patient with the tumor of

the forearm being well at the time of last report 6 years and 7 months after amputation.

Of the 152 cases 70 represent fibrogenic sarcoma 57 spindle cell sarcoma, 17 myxosarcoma or fibromyxosarcoma and 8 cellular anaplastic sarcoma.

Recurrent tumors nearly always show the same structure as the primary growths and in persistently recurring tumors the structure and degree of malignancy are essentially the same for each recurrence. We have been unable to substantiate the view that with each recurrence the tumor is likely to become more and more malignant. The only appreciable variation seen in recurrences is in regard to the amount of myxomatous tissue present. A recurrent tumor may be more or less myxomatous than its predecessor, without showing any other alteration in its cellular structure. There is no evidence that a recurrent fibrogenic tumor may change its structure and become a compact spindle cell tumor, and neither is there evidence that a change may occur in the opposite direction.

There are certain clinical as well as histological features which distinguish fibrogenic and cellular spindle-cell sarcomas. The average age of patients with fibrogenic sarcoma was 48.2 years as contrasted with an average age of 36.3 years for patients with spindle cell tumors. The average age of the 17 patients with myxosarcoma was 49.4 years. Although extremely malignant, spindle cell tumors taken as a group run a longer average duration before producing death than do fibrogenic tumors the average duration of life from the onset of symptoms until death being 60.9 and 58.4 months respectively. A more marked contrast is obtained if a comparison is made between the duration of spindle cell and fibrogenic tumors of a comparable degree of malignancy, the average duration of life in fatal cases of the latter group (grade 3 and 4 tumors on a basis of 1 to 4) being only 39.7 months. An explanation of these observations is afforded by the fact that although many patients with spindle cell tumors die within 2 to 4 years from the onset of the disease there are a considerable number of tumors which persistently recur for many years before causing death while in other instances

TABLE I -- DISTRIBUTION OF DIFFERENT TYPES OF SARCOMA ACCORDING TO LOCATION AND TO SEX OF PATIENT

Type	Location	Fibrogenic sarcoma (myxosarcoma)		Spindle cell sarcoma		Total
		Males	Females	Males	Females	
Subcutaneous		4			0	6
Arm			2	6	1	10
Forearm		0	0		3	3
Forearm		6		3	4	4
Hand				1		4
Thigh		5	4	3	0	51
Buttock		40	78.4	25.0	78.5	100
Lower extremity						
Buttock		3				0
Thigh		4	3	7	4	45
Lower extremity of popliteal space		3	4	0		18
Leg		0	6	2	3	
Foot				4		0
Total		3	25	34	9	
Percentage		0.70	77.7	33.6	8.9	100
Unclassified		55	3	47	15	15
Percentage		36	1	30.2	8.4	100



Fig 1. Aberrant bone and bone marrow formation in a recurrent spindle-cell sarcoma of the popliteal space. $\times 30$. Amputation was performed and there was no recurrence at time of death 20 years 3 months afterward (Fig 7 SURG. GYNEC. & OBST. 1936 62 1010-1019).

Fig 2. Grade 4 spindle cell sarcoma with secondary involvement of the humerus, radius, ulna, and elbow joint present in a woman aged 62 years. Amputation death 4 months afterward from recurrence in stump and generalized metastasis.

the patients die of late pulmonary metastases many years after the original tumors were clinically cured. In other words, spindle cell tumors tend to keep on recurring until they finally kill the patient, even though it may take many years. Late recurrences are, on the other hand, less frequently seen in fibrogenic tumors and consequently the chances for cure are better than for spindle cell tumors after a certain period of time has elapsed without recurrence.

Fibrogenic sarcomas and myxosarcomas, especially those of lower grades, are more often encapsulated than spindle cell tumors. Of 73 encapsulated tumors, there were 48 (65.8 per cent) which fell under the fibrogenic and myxosarcomatous group. Non-encapsulated and infiltrating tumors were about equally divided between the two types, while ulceration occurred approximately twice as frequently in fibrogenic as it did in cellular spindle cell sarcomas, 16 and 7 cases, respectively.

Of 21 tumors attached to or surrounding important nerves there were 9 fibrogenic sarcomas, 2 myxosarcomas, and 10 spindle cell sarcomas. In 10 instances in which large vessels were adherent to or surrounded by the

tumor, there were 6 fibrogenic sarcomas, 1 myxosarcoma, and 3 cellular spindle cell sarcomas.

Secondary muscle invasion occurred in approximately the same proportion as the incidence of the 2 groups, 24 fibrogenic and 17 spindle cell sarcomas.

The anatomical location had no relation to the type or grade of the tumor (Table I), except that sarcomas of muscle and muscle sheaths were usually of the fibrogenic type (14 fibrogenic and 5 spindle cell tumors).

MICROSCOPIC DIAGNOSIS

The microscopic diagnosis of fibrosarcoma is usually clear and is established by the characteristic structure and the presence of dividing cells. However, in many slowly growing cellular, spindle cell sarcomas, the degree of malignancy may be considerably underestimated, particularly if the number of mitotic figures alone is taken into consideration. Every very cellular "fibroma" should be looked on with suspicion and widely excised (Bloodgood).

Reparative and inflammatory reactions occasionally show mitosis of fibroblasts but they are generally easily distinguished from

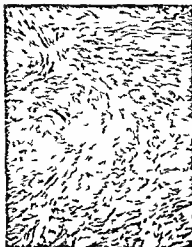


Fig 3



Fig 4



Fig 5

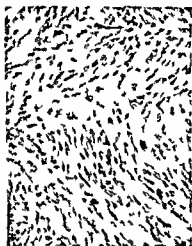


Fig 6

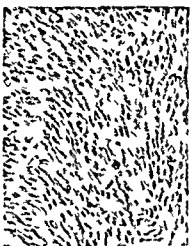


Fig 7

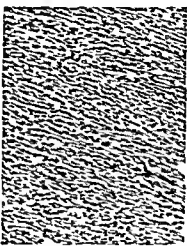


Fig 8



Fig 9



Fig 10

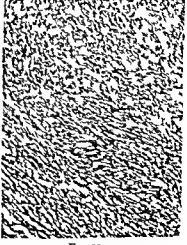


Fig 11

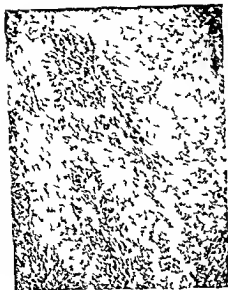


Fig 12



Fig 13



Fig 14

Fig 3 Grade 1 fibrogenic sarcoma $\times 110$. This was a small encapsulated tumor of the thenar eminence. Local excision followed by radium therapy. No recurrence at end of 6 years (Fig 4a SURG. Gynec. & Obst. 1936 62 1010-1019)

Fig 4 Grade 1 fibrogenic sarcoma from the plantar surface of the foot showing marked collagen production. There were similar tumors involving the plantar surface of the other foot and left arm $\times 128$

Fig 5 Recurrent grade 2 fibrogenic sarcoma of the leg in a woman aged 40 years. Treatment consisted of wide local excision and extensive roentgen therapy. There had been no recurrence at time of last report 9 years 4 months afterward $\times 128$

Fig 6 Grade 3 fibrogenic sarcoma primary in the thigh of a 54 year old man. Marked variation in size of nuclei, many mitotic figures and moderate fibrogenesis. Patient died of pulmonary metastasis following multiple local excisions and amputation $\times 128$

Fig 7 Grade 4 fibrogenic sarcoma showing numerous mitotic figures. Section from a large tumor originating in the soft tissues over the right scapula in a 62 year old man $\times 128$

Fig 8 Grade 4 spindle-cell sarcoma showing closely packed hyperchromatic nuclei of almost identical size and a few collagen fibrils. Tumor of the popliteal space surrounding the popliteal vessels and nerves in a 23 year old man $\times 128$

Fig 9 Grade 4 spindle cell sarcoma involving the sciatic nerve in a 36 year old man $\times 128$

Fig 10 Same tumor as shown in Figures 2 and 12. Rapidly growing spindle-cell structure, intercellular reticulum and few collagen fibrils $\times 158$

Fig 11 Transition form between cellular spindle-cell tumors and certain fibrogenic tumors. Loosely arranged spindle cells separated by reticulum. Grade 2 fibrocellular sarcoma of the left forearm in a 67 year old man. Before the appearance of this tumor a similar but more fibrous sarcoma had been removed from the left thigh. Later

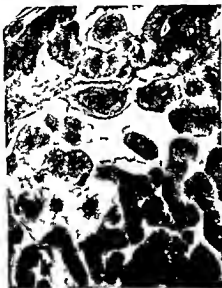


Fig 15



Fig 16

multiple subcutaneous and visceral tumors developed producing death. The patient had no clinical evidence of von Recklinghausen's disease $\times 48$

Fig 12 Same tumor as shown in Figure 2. Spindle-cell structure showing edematous changes $\times 46$

Fig 13 Grade 2 fibromyosarcoma. Very large encapsulated tumor of the thigh involving the quadriceps muscle. Death 1 year after excision probably from intra-abdominal metastasis (Fig 4b SURG. Gynec. & Obst. 1936 62 1010-1019) $\times 60$

Fig 14 Grade 4 anaplastic sarcoma with marked variation in cell size and non-collagenous intercellular substance. This tumor originated in the subcutaneous tissues of the thigh of a 69 year old man $\times 130$

Fig 15 Topography of perithelioma. Grade 4 perivascular spindle cell sarcoma. Third recurrence of tumor of buttock in a 25 year old man. Death from recurrence and metastasis to lungs and ribs $\times 67$

Fig 16 Structure of tumor shown in Figure 15. Highly malignant hyperchromatic cells radiating from an arteriole (Fig 5 SURG. Gynec. & Obst. 1936 62 1010-1019) $\times 91$

sarcoma The presence of pathological mitosis is of little practical value in the diagnosis of malignancy of connective tissue tumors for when it does occur it is usually in an obviously highly malignant growth

Tumors most often confused with fibrosarcoma are angio endothelioma and rhabdomyosarcoma Many so called angiosarcomas and endotheliomas present a structure very similar to small spindle cell sarcoma However the presence in foci of an alveolar arrangement of the cells or the complete or abortive formation of numerous small vessels is strongly suggestive of a vascular origin Endotheliomas can usually but not always be distinguished by the nearly exact uniformness in the size of the cells plump oval or rounded nuclei and the absence of intercellular substance The presence of prominent nucleoli in small oval and spindle cell tumors may be of diagnostic aid for nucleoli are usually not prominent in spindle cell sarcomas but are frequently conspicuous in soft tissue endotheliomas Notwithstanding these histological differences it may be impossible to determine the exact genesis of certain tumors

A group of highly malignant sarcomas present as a characteristic feature numerous very large polymorphous tumor giant cells having a violaceous staining granular cytoplasm with round oval or irregularly shaped nuclei of various sizes Frequently the cells assume an elongated spindle form and occasionally they present longitudinal fibrils which are sometimes cross striated At other times a distinctly foamy appearance of the cytoplasm recalls the structure of congenital rhabdomyoma of the heart Often there is little intercellular substance again there are many collagen fibrils while a myxomatous ground work is sometimes present Areas in certain tumors may exactly simulate fibrogenic sarcoma There is considerable evidence that these particular tumors represent rhabdomyosarcomas originating from skeletal muscle Montpellier collected from the literature 12 cases of authentic rhabdomyosarcomas of the extremities (Marchand Nanotti, Genevet 3 cases Fujinami (28), Burgess Amunategui Muller Johan Stulz Diss and Fontaine Abrikossoff) Three additional cases include

those of Wolbach (59 60), Wagner, and Croxson These tumors however are not as infrequent as the number of reported cases would indicate (16 of 232 soft tissue sarcomas reviewed in our study) Rakov has recently studied 17 muscle tumors 15 of which he interpreted as rhabdomyoblastomas Their occurrence is frequently masked under the diagnosis of giant cell sarcoma neurosarcoma fibrosarcoma or myosarcoma Differentiation from fibrosarcoma is at times made with difficulty However the characteristic foamy giant cells are strongly indicative of the true nature of the growth Primary fibrosarcoma of muscle or secondary invasion of muscle by extramuscular sarcoma may now and then produce a picture similar to rhabdomyosarcoma but these tumors can usually be distinguished

MALIGNANCY INDEX OF FIBROSARCOMA

In this study we have more or less utilized the fundamental principle of cell differentiation in the grading of the sarcomas a principle which was employed by one of us (Bmders) in the grading of carcinomas (11-17)

Quick and Cutler divided soft tissue sarcomas into three grades to designate their relative malignancy Acellular, fibrous growths composed of large spindle cells lying in a dense stroma of hyaline fibrous material were classed as grade 1 tumors Cellular sarcomas composed of large spindle cells with very little intercellular substance were considered as grade 2 malignancies while very cellular tumors composed of small spindle cells arranged in whorls and fasciculi or of polyhedral cells growing diffusely in a loose fibrillar network were defined as grade 3 malignancies

Grynfeldt recognized fibrillar and pseudofibrillar varieties The fibrillar tumors contain collagen fibrils which according to Grynfeldt are crystallized outside the cells in the colloidal intercellular gel The fibrillar variety contains no collagen fibrils except in the stroma while pseudofibrillar tumors are without fibers except in those portions adjacent to blood vessels Grynfeldt expressed the opinion that fibrillar and pseudofibrillar growths are the more malignant He had however too few cases to prove this point

Stewart and Copeland, and French graded essentially according to the system of Quick and Cutler. Of 73 cases included in Stewart and Copeland's series, 16 were graded 1, 36 graded 2, and 21 graded 3. The prognosis was decidedly better in grade 1 than in grade 2 and 3 tumors (55).

Geschickter (32) made a sharp contrast between fibrospindle cell sarcoma, which showed a histological composition of fibroblasts, spindle cells, or small oat cells, and neurogenic sarcoma. Geschickter found a good prognosis in the low grades of fibrospindle cell sarcoma and a poor prognosis in the higher grades of malignant oat cell sarcoma in the fibrospindle-cell series. Those tumors which he called neurogenic sarcomas were all extremely malignant.

In discussing sarcomas of the nerve sheaths Geschickter (32) stated "Histologically there is a remarkable degree of uniformity in the majority of these tumors. They are composed of tightly interlacing strands of plump spindle cells which may occasionally be elongated with wavy fibrils and at other times show enlarged nuclei with mitotic figures and tumor giant cell formation. From this typical picture, which can be considered grade II or III sarcoma, the tumors vary on the one hand toward the benign myxoid neurinomas, merging imperceptibly with the histological forms of this benign group, which may be termed the grade I sarcomas, and on the other hand a group showing numerous tumor giant cells and epithelioid forms, representing grade IV in malignancy." Figure 32 of this publication by Geschickter is a reproduction of a photo micrograph of a very cellular compact, afibrogenic, small spindle cell tumor which he called a grade 2 sarcoma of the nerve sheath.

In a later publication Geschickter and Lewis (33) divided fibrosarcoma (excluding their neurogenic variety) into differentiated and undifferentiated types. The differentiated sarcomas were composed of malignant fibroblasts and collagen, and graded into fibromas, while the undifferentiated tumors were composed of tightly packed cells with little intercellular substance.

Sections taken from different parts of a given fibrosarcomatous tumor nearly

always show the same structure. Consequently, any given section is usually representative of the nature of the bulk of the tumor. Considerable reliance can therefore be placed on microscopic sections, provided the tumor itself and not extraneous fibrous tissue is included. When there is much edema or myxomatous tissue, several sections from various parts of the tumor should be studied in order to include any very cellular areas, which, if present, are indicative of the true nature of the growth.

In order to arrive at definite criteria governing the grading of sarcoma, the tumors of the 152 cases were classified both according to the relative amounts of collagen fibrils and cellular elements and according to the number of mitotic figures and tumor giant cells which they presented.

At first the tumors were divided into four groups in relation to the number of mitotic figures and tumor giant cells. In group 1 were placed those tumors showing a minimum number of mitotic figures, in group 4 those with a maximum number of mitotic figures and tumor giant cells, and in groups 2 and 3 those tumors having an intermediate amount of these elements. Grading by this method was extremely unsatisfactory and unreliable.

The tumors were then grouped into 3 classes according to the relative proportion of fibers and cells so that the following types were distinguished: (1) fibrous tumors, (2) fibrocellular tumors, and (3) cellular afibrous tumors. The first group represented fibrogenic sarcoma, the second group, fibrogenic sarcoma, fibromyxosarcoma and myxosarcoma, and the third group, cellular spindle cell and anaplastic cellular sarcoma. Table II shows the frequency of these tumors.

All cellular spindle cell afibrogenic tumors are extremely malignant, irrespective of the number of mitotic figures which they exhibit. In 6 cases of cellular spindle cell tumors showing a minimum number of mitotic figures there were no cures. Likewise, in 25 cases of the same type of tumor showing a moderate number of mitotic figures there were but 2 cures, while in 19 cases in which the tumors showed numerous mitotic figures there was 1 cure. Of 7 traced patients having cellular ana-

TABLE II—TYPE AND GRADE INCIDENCE OF 152 CASES

I d x f m i g n y	F b r	F b l u	T o t	P e r c e t	C l	T t a l	P e r c e t
G d e		4	24	7.59		34	5.8
G d 2	7	8	35	4.3		35	3.0
G d 3	3		3	26.44		3	5
G d 4	0	5	5	5.75	65	7	46.0
T t a l	3	57	87	00	65	15	
P e r	34.48	65.5	100				
P e r c e n t l i c e s	9.74	37.50	57.4		4.76		00

plastic sarcomas which were not typical spindle cell tumors, there was 1 cure. More over in cellular spindle cell sarcoma there is no relation between the number of mitotic figures and the duration of the disease in fatal cases. The shortest survival period however is observed in anaplastic cellular sarcoma where the average duration of life in 6 fatal cases was but 21 months.

On the other hand the number of mitotic figures is an accurate guide in estimating the malignancy of fibrous and fibrocellular tumors. The relative malignancy however determined by the number of mitotic figures decreases in inverse proportion to the number of fibers. Nevertheless for practical purposes fibrous and fibrocellular tumors have been considered under one group for as the index of malignancy increases more and more tumors fall under the fibrocellular group. Thus there were only 3 grade 3 and no grade 4 fibrogenic sarcomas which could be called fibrous (Table II).

The malignancy of fibromyxosarcoma is likewise directly proportional to the number of mitotic figures and tumor giant cells. Of 16 traced patients with myxosarcoma there were 7 grade 1, 6 grade 2 and 3 grade 3 tumors. There were 4 cures among the tumors of grade 1, 2 among those of grade 2 and none among those of grade 3.

The duration of life in fatal cases of fibrogenic sarcoma and myxosarcoma is similarly inversely proportional to the grade of the tumor. In 12 grade 1 tumors the average duration of life from the onset of symptoms until death was 100.6 months in 19 grade 2

tumors it was 51.4 months, in 15 grade 3 tumors it was 43.2 months, and in 5 grade 4 tumors it was 29.3 months.

If all cellular tumors are included under grade 4 and fibrous and fibrocellular tumors are combined of 2, traced patients with tumors of grade 1, 45.5 per cent were cured of 30 traced patients with tumors of grade 2, 36.7 per cent of 18 traced patients with tumors of grade 3, 16.7 per cent and of 6 traced patients with tumors of grade 4, 6.5 per cent were cured. Of the 28 cures, 24 had persisted for over 5 years and 4 for 3 to 5 years at the time of last report.

For further details concerning treatment, final results and prognosis reference is given to our previous publication (45).

SUMMARY

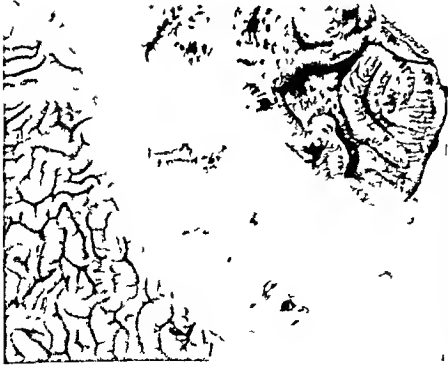
A synopsis of the pathological features of fibrosarcoma, based on a study of 152 cases is presented. Fibrogenic and cellular spindle cell sarcomas constitute for the most part two distinct clinical and pathological groups. Fibrogenic sarcomas and myxosarcomas usually occur in older patients than do spindle cell tumors. The clinical course of spindle cell sarcoma is often prolonged and the prognosis not good (7 per cent cures). The prognosis in cases of fibrogenic sarcoma and myxosarcoma is fairly good (32 per cent cures). Group prognosis can with considerable accuracy be determined by the microscopic structure of the tumor. The malignancy of fibrogenic sarcoma and myxosarcoma is directly proportional to the number of mitotic figures and tumor giant cells which the tumors contain. Of fibrogenic tumors having an equal number of mitotic figures those with an abundance of fibers are less malignant than those showing less fibrogenic qualities. Cellular spindle cell sarcomas are all highly malignant irrespective of the number of mitotic figures and should be classed as grade 4.

REFERENCES

1. ABRILOSOFF A. Ueber Myome ausgehend von der quergestreiften Muskulatur. *Arch f path Anat* etc 1926 260 215-233.
2. AMATEYER G. Sarcomas primitivos de los musculos. *Semana med* 1914 21 639-640.
3. BENNETT J H. On cancerous and canceroid growths. *Edinburgh, Sutherland and Knox* 1849.

- 4 BICK L M Tumors of the nerve sheaths of the extremities neurogenic sarcomas J Bone & Joint Surg 1931 13 149-153
- 5 Idem Skeletal muscle sarcoma Ann Surg 1934 99 949-956
- 6 Idem Fibrosarcoma of the extremities Ann Surg 1935 101 759-765
- 7 BILLROTH THEODORUS Lectures on surgical pathology and therapeutics London The New Sydenham Society 1877-1878 vol 2 x 438 pp, xi 543 pp
- 8 BIRKETT J Contributions to the practical surgery of new growths or tumors Series II—Fibrous plastic growths Guys Hosp Rep 1858 4 231-266
- 9 BLOODGOOD J C Diagnosis and treatment of borderline pathological lesions Surg Gynec & Obst 1914 18 19-34
- 10 BORRMAN Quoted by Zeit F R
- 11 BRODERS A C Squamous cell epithelioma of the lip a study of five hundred and thirty seven cases J Am M Ass 1920 74 656-664
- 12 Idem Squamous-cell epithelioma of the skin a study of 256 cases Ann Surg 1921 73 141-160
- 13 Idem Epithelioma of the genito urinary organs Ann Surg 1922 75 574-604
- 14 Idem Cancer's self control Med J & Rec 1925 121 133-135
- 15 Idem Epithelioma of the cavities and the internal organs of the head and the neck Arch Surg 1925 11 43-73
- 16 Idem The grading of carcinoma Minnesota Med 1925 8 726-730
- 17 Idem Practical points on the microscopic grading of carcinoma New York St J Med 1932 32 667-671
- 18 BURGESS A M Malignant rhabdomyoma with multiple metastases J Med Research 1914 29 447-455
- 19 BUTLIN H T Recurrent ossifying spindle celled sarcoma from the subcutaneous tissue of the thigh Tr Path Soc London 1873 24 211-13
- 20 CORNILL V and RANVIER L A Manual of Pathological Histology Philadelphia Henry C Lea 1880
- 21 COUREAUD DALGER and SEGUY Trois cas de tumeurs musculaires primitives Bull et mem Soc nat de chir 1906 52 102-1207
- 22 CROSSAN E T Unusual tumors of the soft parts Surg Clin N America 1929 9 1245-1271
- 23 EBERTH Quoted by Zeit F R
- 24 EWING JAMES Neoplastic Diseases 3d ed Philadelphia W B Saunders Company 1908
- 25 Idem Fascial sarcoma and intermuscular myxoid sarcoma Arch Surg 1935 31 507-520
- 26 FOX S L Sarcoma of the breast with a report of sixty cases Ann Surg 1934 100 401-421
- 27 FRENCH R W End results in a series of sixteen cases of fibrosarcoma New England J Med 1932 206 393-395
- 28 FUJIMAWA AKIRA Ein Rhabdomyosarcom mit hyaliner Degeneration (Cylindrom) im willkuerlichen Muskel (Beitrage zur pathologischen Anatomie des quergestreiften Muskels) Arch f path Anat etc 1900 160 203-226
- 29 Idem Ueber das histologische Verhalten des quergestreiften Muskels an der Grenze hoersartiger Geschwuelste (Beitrag zur pathologischen Anatomie des quergestreiften Muskels) Arch f path Anat etc 1900 161 115-158
- 30 GENEVEY EDOUARD Etude anatomo-pathologique du rhabdomyome en general et en particulier du rhabdomyome malin Lyon L Bourgeois 1900
- 31 GESCHICKTER CHARLES F So called fibrosarcoma of bone bone involvement by sarcoma of the neighboring soft parts Arch Surg 1932 24 231-291
- 32 Idem Tumors of the peripheral nerves Am J Cancer 1933 25 377-410
- 33 GESCHICKTER CHARLES F and LEWIS DEAN Tumors of connective tissue Am J Cancer 1935 25 630-655
- 34 GRUYFELT E Trame collagene et fibrologene dans les sarcomes du tissu conjonctif Bull de l Ass franc p l etude du cancer 1920 18 360-377
- 35 HERTZLER A E Surgical Pathology of the Skin Fascia Muscles Tendons Blood and Lymph Vessels Philadelphia J B Lippincott Co 1931
- 36 HUTHCHINSON, J JR A case of ossifying sarcoma of the flexor longus digitorum muscle Tr Clin Soc London 1903 38 230-231
- 37 JAFFE R H Recurrent lipomatous tumors of the groin liposarcoma and lipoma pseudomyxomatodes with two plates Arch Path 1926 1 381-387
- 38 JAIDAA K C Ossifying sarcoma of vastus externus Brit M J 1910 2 379-380
- 39 JORAN B Ein Rhabdomyosarcoma chondro-myxomatodes des Oberarmes Frankfurt Ztschr f Path 1919 22 50-68
- 40 LANCEREAU Quoted by Watson B A Fibro spindle-celled sarcomatous tumors with the report of a case and presentation of the specimen J Am M Ass 1886 7 421-425
- 41 LEADINGHAM R S The histologic reaction of muscle tissue to the presence of a rapidly growing malignant tumor Am J Cancer 1932 16 556-560
- 42 LEBERT Quoted by Burlett J
- 43 MARCHAND FELIX Ueber eine Geschwulst aus quer gestreiften Muskelfasern mit ungewoehnlichem Gehalte an Glykogen nebst Bemerkungen ueber das Glykogen in einigen foetalen Geweben Arch f path Anat etc 1885 100 42-65
- 44 MEYERDING H W Eleven year cure of sarcoma following amputation Surg Clin N America 1927 1440-1442
- 45 MEYERDING H W BRODERS A C and HARGRAVE R L Clinical aspects of fibrosarcoma of the soft tissue of the extremities Surg Gynec & Obst 1936 62 1010-1019
- 46 MONTPELLIER J Les rhabdomyomes caracteres genaux et varietes anatomocliniques Etude critique Bull de l Ass franc p l etude du cancer 1929 18 338-602
- 47 MULLER H R Traumatic rhabdomyosarcoma following successive fractures of the femur J Cancer Research 1917 2 393-399
- 48 NANOTTI Quoted by Montpellier J
- 49 PAGET J Lectures on Surgical Pathology, 3d ed Philadelphia Lindsay & Blakiston 1865
- 50 QUICK DOUGLAS and CUTLER MAX Neurogenic sarcoma a clinical and pathological study Ann Surg 1927 86 810-829
- 51 RAKOV A I Malignant rhabdomyoblastomas of the skeletal musculature Am J Cancer 1937 30 435-476
- 52 RYAN THOMAS and CAMERO A R Neurogenic sarcoma Ann Surg 1935 101 1455-1458
- 53 SIMMONS C C Sarcoma of the soft parts observed at the Collis P Huntington Memorial hospital 1924-1929 Results of treatment Am J Cancer 1935 25 621-623

- 54 SOKOLOW A A Ueber die Entwicklung des Sarkoms in den Muskeln Arch f path Anat etc 18,3 57 321-340
- 55 STEWART F W and COPELAND M M Neurogenic sarcoma Am J Cancer 1931 15 1235-1320
- 56 STILZ E Diss A and LONTAINE R Myxosarcome de l'avantbras d'origine musculaire Bull Soc anat de Par 19 3 03 429-432
- 57 VIRCHOW RUDOLF Die krankhaften Geschwuelste Berlin Hirschwald 1864-1896
- 58 WAGNER J H Rhabdomyosarcoma of the buttock Atlantic M J 1928 31 570-571
- 59 WOLBACH S B Centrioles and the histogenesis of the myofibril in tumors of striated muscle origin Anat Rec 1928 37 235 273
- 60 Idem A malignant rhabdomyoma of skeletal muscle Arch Path 1928 5 775-786
- 61 ZEIT I R Morphologic and histogenetic characteristics of endothelial tumors J Am M Ass 1906 46 567-576



For the experiment 18. Distal portion of the stomach which has been exposed to tenth normal by lincloine was isolated and the pyloric region which has been normal by most of its blood supply by clamping the arteries. Change in swelling mucosal membranes, necrosis and irritations are seen in the pyloric region. The mucosa in the region which has been normal is normal. The epithelium has also been exposed to tenth normal hydrochloric acid solution.



Fig. 4. Experiment 21. Upper portion of dog's stomach with ligation of the upper portion had been interfered with by ligature of arteries to teeth normal by tracheotomy and had been injected into the stomach. Hemorrhages in a number of superficial ulcerations surround it; a grayish border line are seen.

Surgical Criticisms—A Study of the Causes of Castration and in the case of 150 males with 171 testicular Atresia etc the So Called Unilateral Castration Associated with Leyer—A Schindler 1904

SURGICAL GASTRITIS

A Study on the Genesis of Gastritis Found in Resected Stomachs with Particular Reference to the So Called "Antral Gastritis"

Associated with Ulcer

R SCHINDLER, M D, H NECHELES, M D, Ph D, and R L GOLD, M D,
Chicago, Illinois

WE have called this paper "Surgical Gastritis" because we have been able to produce a picture of gastritis in dogs using the technique of subtotal gastrectomy and other methods in which we ascertained the presence of a normal stomach before operation. Two different ideas led us to the investigation reported here. (1) The recent discussion on geographical differences in the occurrence of gastritis in stomachs resected for ulcer (Walters and Sebening) has been inconclusive in so far as in this country as well as in Europe results in this field were contradictory. Geographic differences in the gastroscopic picture of the ulcer stomach are denied by Schindler and associates. (5) (2) The picture of ulcerative antrum gastritis which Konjetzny and co-workers (1) believe to accompany duodenal and gastric ulcer usually was not found gastroscopically in ulcer bearing stomachs, even not in untreated cases, though occurring as an independent disease. (4)

The question, therefore, arises whether the differences in the occurrence and intensity of gastritis in ulcer cases, as reported from different countries, and the discrepancy between anatomical and gastroscopic findings may not be due to differences in surgical technique rather than to differences in the patients. The idea underlying our experiments was that during subtotal gastrectomy the relatively slow deprivation of blood of the stomach of an

ulcer patient might produce changes of acute gastritis and erosion at least in such individuals who have a continuous secretion of hydrochloric acid. It has been shown that continuous secretion of acid occurs frequently in persons suffering from duodenal ulcer. (7)

METHODS

Dogs were starved for 24 hours, and anesthetized with ether or with pentobarbital sodium. A small piece of the anterior gastric wall was resected at the border between pyloric antrum and body of the stomach. The opening in the wall of the stomach was closed by sutures and the excised specimen put between filter paper and immediately immersed in 10 per cent formalin. After this various procedures were employed.

1 Excision of the stomachs of anesthetized healthy dogs.

2 Subtotal resection of the stomach. Pylorus and duodenum were separated between clamps and the duodenum was inverted. A rubber covered elastic clamp was applied across the fundus below its upper third, then the blood vessels of the lower two thirds of the stomach were ligated as usual in gastric resections.

3 Resection of the pyloric antrum only. The same procedure was employed as in 2, but the clamp was placed just above the pyloric antrum.

4 Ligation of arteries. Various arteries supplying the stomach were ligated: the arteria lienalis below the origin of the left gastric artery, the left or right gastric artery on the lesser curvature, the gastro epiploic artery in the middle of the greater curvature and recurrent branches from the spleen.

From the Department of Gastrointestinal Research of Michael Reese Hospital and the Department of Medicine University of Chicago. Aided by the O. Baer Funds.

Presented before the American Gastroenterological Association, May 1, 1939.

The authors are obliged to Dr. Jerome Strauss for taking the colored photographs.

Dr. Gold is now in San Francisco.

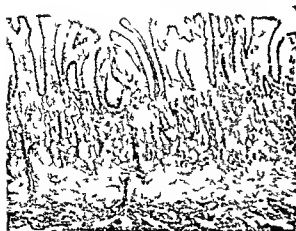


Fig 2 Experiment 18 Microscopic section of a biopsy taken from the pyloric portion of the dog's stomach pictured in Figure 1 before the operation



Fig 3 Experiment 18 Microscopic section through the same region as pictured in Figure 2 but after the operation showing a superficial erosion

5 to 8 In none of the experiments presented in groups 1 to 4 was free acid found in the excised stomachs Using these experiments as controls the same procedures were repeated with the presence of free acid in the stomachs of the experimental animals Most patients with duodenal ulcer have not only a high gastric acidity on stimulation but also a continuous and night secretion of hydrochloric acid In order to simulate the gastric secretion of acid in the ulcer patient in this group of experiments the following procedures were employed about 100 cubic centimeters of tenth normal hydrochloric acid was introduced (al-

ways by gravity) into the whole stomach or into the segment above the clamp (resections) a small quantity of tenth normal hydrochloric acid was introduced into the part to be resected or acid secretion of the stomach was stimulated by subcutaneous injection of histamine or acetyl beta methylcholine¹

In every experiment the dog was covered and left on a heated operating table for about 2 hours after the beginning of the various procedures i.e. after ligation of arteries and of introduction of the hydrochloric acid into the stomach This was done in order to simulate the average duration of a gastric resection in a patient by a skillful surgeon At the end of that period a clamp was applied to the celiac artery and the stomach was excised and opened along the greater curvature Pieces of tissue were excised and placed in 10 per cent formalin between filter paper Photographs of the specimen were taken before the natural colors faded out All these procedures were done within a few minutes after excision of the stomach

RESULTS

Normal stomachs in which acid secretion had not been stimulated previous to the operation and which did not contain any acid secreted spontaneously or introduced artificially did not show erosions or other signs



Fig 5 Experiment 21 Microscopic section through one of the erosions shown in Figure 4 The ulcer floor especially at the edge of the ulcer is covered by fibrinous exudate

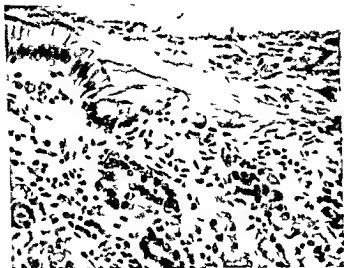


Fig 6 Experiment 21 Same microscopic section as in Figure 5, higher power. The edge of the ulceration with the fibrinous exudate is seen. The exudate contains cells.

cant pathological changes after the various surgical procedures, i e, neither after ligation of arteries or partial gastrectomy (using clamps). In the case of controls, using stomachs not operated upon, stimulation of acid secretion of the stomach, or artificial introduction of hydrochloric acid into the gastric cavity did not produce per se any pathological changes either. On the contrary, those parts of the stomach which were deprived in part, or more or less completely, of their blood supply for a duration of 2 hours and which either were exposed to hydrochloric acid by introduction of same or by stimulation of gastric secretion by drugs, showed more or less intense ulcerations, petechiae, and hemorrhages, according to the degree of anemia of the stomach and according to the degree of acidity prevailing in the resected part. That part of the stomach in which the blood supply was left intact and into which acid had been introduced or into which acid had been secreted following stimulation by drugs, did not show any changes from a normal stomach.¹ Twenty-one operations were performed four of which will be described in detail as illustrative of the general results.

Experiment 18 In this experiment a most thorough occlusion of blood supply to the pylorus was



Fig 7 Experiment 8 Microscopic section through the body mucosa of a dog's stomach. The blood supply of the upper portion of this stomach had been diminished by ligation and tenth normal hydrochloric acid had been introduced into its lumen. Ulcerations were seen only in that portion of the stomach the blood supply of which had been interfered with. This figure shows a section through one of the ulcerations. Plasma cell staining with methyl green pyronin (appearing black in the photograph).

performed as described. Two hours before operation 3 milligrams of apomorphine hydrochloride was administered, followed in 1 hour by an anesthetic dose of sodium pentobarbital intravenously. The stomach was then washed several times with warm saline. After the peritoneal cavity was entered blood vessels at the lesser and greater curvature of the antrum were ligated, and the duodenum was sectioned between clamps. A rubber covered elastic clamp was applied at the level of the incisura. Hydrochloric acid, tenth normal (10 c cm 38 degrees C) was in

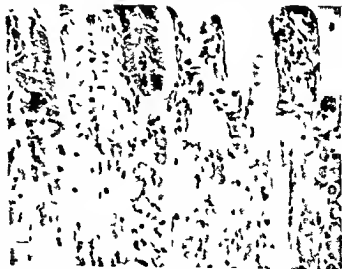


Fig 8 Experiment 8 Edge of the ulceration of the same section as in Figure 7 under higher power. Many plasma cells are seen as a proof for the rapid inflammatory tissue reaction.

¹Interestingly Konjetzny¹ treated some of his patients with hydrochloric acid pre-operatively. He does not let his patients fast before operation on atropine; given before operation. During the operation elastic clamps are applied across the upper part of the stomach (2).



Fig 9 Experiment 8 Same section as in Figures 7 and 8 Mucosa in the next surroundings of the ulcer Many plasma cells are still seen here



Fig 10 Experiment 8 Same section as in Figures 7 and 9 Mucosa a few millimeters distant from the ulceration Almost no plasma cells are seen

jected into the antrum through the proximal cut end of the duodenum and 80 cubic centimeters 38 degree C was injected into the stomach above the clamp by means of a needle and force of gravity. One and one half hours after the injection of acid and 2 hours after the beginning of operation the entire stomach was excised in a few seconds. It was quickly opened on the greater curvature sections for microscopic study were immediately taken and placed in formalin. The specimen was then photographed only a few minutes after excision and before fading of the natural colors.

Macroscopically the serosa of the portion of the stomach below the clamp was deeply cyanotic but of normal color above the clamp. The mucosa above the clamp was normal. Below the clamp most of the mucosa appeared deeply cyanotic edematous and covered with hemorrhages erosions ulcers and adherent greenish gray mucus. The specimen and the histology of this experiment are presented in Figures 1 2 and 3.

As seen in the colored picture (Fig 1) the lesions are extensive this was the most radical of our experiments showing most pathological changes. The blood supply to the pyloric antrum had been interrupted nearly completely. However the musculature of the pylorus of the dog is so powerful that the application of an elastic clamp does not prevent some blood supply from collateral branches in the gastric wall from entering the segment clamped off. Interestingly the changes in the distal part of the antrum were less severe than those in its proximal part. A similar picture of a resected human stomach has been reported by Konjetzny (1 Fig 6 p 38).

Experiment 1 (Fig 4) The dog was prepared as described above. The left gastric and splenic and the epiploic and coronary arteries were ligated the two latter ones at the height of the incisura so as to interrupt most of the extrinsic circulation to the upper portion of the stomach. One hundred cubic centimeters of tenth normal hydrochloric acid 38 degrees C was injected into the stomach. Ninety minutes after the beginning of the arterial ligations the stomach was excised. It contained free acid. Sections and photographs were taken as in previous experiment. The serosa and mucosa of the body appeared slightly cyanotic. In the mucosa of the body about 10 small superficial punched out ulcers appeared most of them on the crest of the folds of the anterior and posterior wall of the body. The antrum appeared completely normal. Interestingly one of the colored pictures of the same region of a resected human stomach from Konjetzny's material bears strong resemblance to Figure 4 (1 Fig 2 p 34). Microscopically (see Figs 5 and 6) the shallow erosions are seen covered by fibrinous exudate containing cells comparable to observations on resected human stomachs (1 pps 49-50). This experiment shows that erosions and exudates may appear not only in the antrum (see previous experiment) but also in the body i.e. wherever the blood supply is deficient and acid present. Also in this case a more or less small amount of blood entered the area whose external supply had been interrupted through collaterals from the esophagus and from that part of the stomach whose blood supply had not been interfered with.

The following two experiments serve to show definite tissue reactions (similar to such described by Konjetzny) in the affected tissues proving that our experimental procedure did not produce corrosion but a picture of inflammatory reactions similar to gastritis.



Fig 11 Experiment 20 Section through the body mucosa of a dog's stomach after subcutaneous injections of histamine and mecholyl and after ligation of most of the arterioles to its left side. Inflammatory ulcerations were produced this figure showing a section through one of them



Fig 12 Experiment 20 This is the same section as shown in Figure 11 only under higher power. The villi at the edge of the ulceration are shown presenting numerous vacuoles and migrating cells which are signs of an inflammatory reaction

Experiment 8 (Figs 7-10) The dog was prepared as previously described. The left gastric artery was ligated and 100 cubic centimeters of tenth normal hydrochloric acid 38 degrees C was injected into the stomach by gravity. Two hours after beginning of ligations the entire stomach was excised and treated as described. In the antrum no ulceration or other pathological changes were present, except some greenish gray mucus at spots. The lower half of the body of the stomach also did not present pathological changes while in the upper half very distinct changes were seen which were limited to the lower half by a rather sharp linear demarcation. Irregular erosions were present, some of them confluent, their size being from a few millimeters to 1 centimeter in diameter. Two of them looked punched out and had undermined edges. On the upper part of the lesser curvature extensive necrosis was seen. On the posterior wall the same changes were present but to a somewhat lesser extent than those noted elsewhere.

Microscopically rather deep mucosal ulcerations were seen. Plasma cell stain (methylgreen pyronin) showed accumulation of plasma cells at the base and at the edge of the ulcer as well as in the immediate adjoining mucosa but not in the apparently normal mucosa distant from the ulceration.

Experiment 20 Ninety, sixty and thirty minutes before anesthesia with pentobarbital sodium, 1 milligram of histamine hydrochloric acid and 1 milligram of mecholyl were given subcutaneously.

The splenic and left gastric arteries were ligated and the gastro-epiploic artery interrupted by ligation at about the middle of the greater curvature and 2 hours after beginning of the ligations the stomach was excised and treated as described. The mucosa above the angulus appeared cyanotic. In the highest portion of the body of the stomach numerous ero-

sions, small ulcers, hemorrhages and areas of necrosis were evident. The number of ulcers was diminishing toward the antrum pylorus. The antrum itself appeared entirely normal.

Microscopically, shallow ulcers are seen. Figure 11 shows the erosion and Figure 12 the mucosa next to its edge, demonstrating the inflammatory reaction of the tissues, while the mucosa distal to the ulcer appears normal (Fig 13).

This experiment again demonstrates that inflammatory reaction can occur during an operation and need not be interpreted as gastritis of older standing. Photomicroscopic pictures similar to ours on the dog's stomach (Fig 12) can be found in resected human stomachs.



Fig 13 Experiment 20 Same section as in Figures 11 and 12. Villi distant from the ulcer showing very few vacuoles and migratory cells

DISCUSSION AND CONCLUSIONS

We were fully aware that the pathophysiology of the dog's stomach is different from that of the human. The occurrence of chronic peptic ulcer in dogs is extremely rare, although the condition of chronic gastritis is not found infrequently in street dogs we were using. We want to stress also that existing pathological conditions in human stomachs will be superimposed by the ulcerative and inflammatory reactions occurring during operation as described and thereby such stomachs may present pictures more complex and shifting than those of our relatively simple experiments. Yet we feel confident that part of our experience can be applied toward the explanation of geographic differences in the occurrence of gastritis in ulcer patients as well as to the problem of gastritis in relation to the genesis of ulcer. It has been claimed by Konjetzny that results of autopsies are not dependable because these do not take place immediately after exitus and postmortem changes in the stomach are unavoidable. He believes that stomachs resected by the surgeon offer an incontrovertible proof for the pre-operative condition of the mucosa because they are absolutely fresh and not subject to postmortem changes. It seems to us however that the same logic as to postmortem changes

may be applied to the specimen of gastric resections and we believe that we have proved this with our experiments and have demonstrated it with the colored pictures and photomicrographs. Our colored pictures and some of our photomicrographs may well be compared with those Konjetzny obtained from his surgical specimens. A stomach partially or totally deprived of its blood supply will show within 2 hours, erosions, ulcerations and inflammatory reaction of the tissue, i.e. gastritis in varying degrees depending on the presence of acid during the operation.

LITERATURE

1. KONJETZNY G. E. Die entzündliche Grundlage der typischen Geschwulstbildung im Magen und Duodenum. Berlin: Springer, 1930.
2. Idem. Personal communication.
3. NACHELES H. and CORVE A. Secretion of mucus and acid by the stomach in healthy persons and in persons with peptic ulcer. Arch. Int. Med. 1935, 55, 395.
4. SCHINDLER R. Gastrospey. The Endoscopic Study of Gastric Pathology, p. 167. Chicago: University of Chicago Press, 1937.
5. SCHINDLER R. and BAXMEIER R. I. Supposed changes accompanying gastric ulcer. A gastroscopic study (in press).
6. WALTERS W. and SEBENING W. A comparison of lesions associated with duodenal ulcer in Germany and in the United States. Minnesota M. J. 1937, 15, 579.
7. WINKELSTEIN A. Studies in gastric secretion during the night with a preliminary note on a new therapy for peptic ulcer. Proc. Am. Gastro-Enterol. Ass. 1931. Quoted from Winkelstein. Am. J. Digest. Dis. 1935, 1, 778.

THE PROBLEM OF INTRACTABLE PEPTIC ULCER

F GREGORI CONNELL, M D, F A C S, Oshkosh, Wisconsin

PEPTIC ulcer in its uncomplicated state is fundamentally a physiological, biochemical problem calling for a restitution of normal function. Such a return to normal can usually be accomplished by proper medical measures, aided, if necessary, by the proper form of surgical care. The basic rationale of treatment has been the neutralization of secreted hydrochloric acid, and this may be accomplished by a great variety of methods. But intractable or recurrent peptic ulcers, as the name implies, do not respond satisfactorily to either medical or surgical treatment alone, they remain medical problems after surgical treatment as well as before. A clearer understanding of the etiology of peptic ulcer is urgently needed, but until such an understanding is accomplished, efforts should be directed toward an earlier recognition of intractable duodenal ulcers, thereby decreasing the frequency of their treatment by gastro enterostomy, and in turn reducing the incidence of the development of jejunal ulcers.

Recurrent, intractable peptic ulcer may be considered as a general disease with a local, usually duodenal, lesion occurring most frequently in young, slender, active, ambitious males with labile nervous and vascular systems. There is often a history of ulcer among other members of the family. Among the usual symptoms of ulcer are gastric hyperchlorhydria, hypersecretion, and hypermotility, hemorrhage or perforation, which are not infrequent, may occur without any premontory digestive complaints. Medical management admittedly fails. The operative treatment, usually gastro enterostomy, has not only been unsuccessful, but a resultant jejunal ulcer has often occurred which may be more serious than the original ulcer. In fact, the frequency of intractable ulcer may be roughly gauged by the percentage of jejunal ulcers which follow gastro enterostomy, variously estimated at from 3 to 34 per cent. Resections of various amounts of the distal

stomach have been followed also by recurrence, and other seemingly radical measures have often proved to be merely palliative.

The rational treatment of any disease presupposes a known cause, but unfortunately in the case of peptic ulcer no theory of cause yet propounded can be wholly accepted. In the 50 or more current theories hydrochloric acid seems to act as a common denominator. Hydrochloric acid is the main important causative factor, because of a disproportion in the ulcer patient between the aggressive, or acid, and the defensive, or alkaline, secretions. The proper treatment of intractable ulcer, therefore, might well aim to diminish the secretion of hydrochloric acid, in contradistinction to its mere neutralization after secretion, which is usually satisfactory with tractable cases. In fact, such an objective has been attempted by both non operative and operative methods.

In the search for an ideal non operative treatment, a physiological method of reducing hydrochloric acid secretion is urgently needed. Belladonna and atropine are useful but because of objectionable oral, ocular, and cardiac effects they are not suitable for prolonged treatment and many modifications of the drugs are being developed. The action of adrenalin and ephedrine is transitory. Risking a resultant anemia, anti secretagogues might be found useful if they were clinically applicable, and enterogastrone of Ivy and histaminase of Banting and Best, when eventually purified for clinical use, are promising. Bromides have been given in the hope of substituting hydrobromic acid for hydrochloric acid in the gastric secretion. The dietary increase of fats is a well recognized adjunct to treatment. Also, the low salt diet suggests itself in the treatment of peptic ulcer, but after trial the desired hypochlorhydria has not been clinically demonstrable, probably due to the large salt reserves in the body fluids. That psychotherapy is of actual value is shown frequently by the immediately favor

EVALUATION OF THE OPERATIVE
TREATMENT

Based upon my experience with 28 cases of jejunal ulcer in evaluation of the results of the operative treatment of intractable peptic ulcer is attempted. These cases have been reviewed after a careful follow up study. Except for one instance of congenital stenosis they developed jejunal ulcer after gastro-enterostomy for duodenal ulcer. The number of operations following gastro-enterostomy were as follows: 1 in 17 patients, 2 in 7 patients, and 3 in 4 patients. Twenty-two were males and 6 were females. The ages varied from infancy to 62 years. The results of the treatment may be conveniently classed under 3 divisions:

A. In 18 of these patients a new gastro-enterostomy was made posteriorly in 17 and anteriorly in 1. Entero-enterostomy was added in 2 and jejunostomy in 1. There was a return of symptoms in all 18 patients.

B. In 6 of the patients the original gastro-enterostomy remains. Of these 2 underwent gall bladder operations, had an entero-enterostomy, 1 had a pyloric exclusion and 1 simply had separation of adhesions. There was a return of symptoms in all 6 patients.

C. In the remaining 4 patients a partial proximal gastrectomy or fundusectomy was performed. In 3 patients there have been no return of symptoms after 4 months, 3 years and 7 years respectively. The fourth patient died of postoperative uremia.

In contrast to these 4 patients treated by fundusectomy, 13 distal gastrectomies resulted in death in 3 patients, the return of symptoms

in 8 patients, and unknown results in 2 patients. Although this series is obviously too small on which to argue the comparative benefits of fundusectomy, it is indicated that this form of operation for the cure of recurrent peptic ulcer may be on a sound physiological basis.

SUMMARY

Intractable peptic ulcers, as the name implies, do not respond satisfactorily to either ordinary medical management or the usual operative treatment. The symptoms which they produce and the type of individuals in which they occur suggest that they may be considered a general disease with a local lesion. Satisfactory non-operative treatment awaits the development of a clinically applicable antisecretagogue with which to diminish the secretion of hydrochloric acid in contradistinction to its neutralization by food or alkalis after secretion, which with other non-operative measures is usually satisfactory in tractable ulcers. The usual operative treatment is gastro-enterostomy, but this may be followed by jejunal ulcer and other complications far worse than the original condition. A rational operative treatment is one that diminishes the secretion of the hydrochloric acid rather than one that chiefly promotes neutralization and in this respect fundusectomy, a modification of subtotal gastrectomy by preservation of the distal stomach and lesser curvature is followed by promising results.

BIBLIOGRAPHY

1. CONNELL, F. C. Partial gastrectomy in treatment of peptic ulcer. *Surgery* 1938 3: 969.
2. HENK. Fundusectomy, a new principle in the treatment of gastric or duodenal ulcer. *Surg. Gynec. & Obst.* 1929 49: 695.

SURGICAL TREATMENT OF ACUTE PROFUSE GASTRIC HEMORRHAGES

Professor H. FINSLERER Vienna, Austria

FORTY TWO years ago Mikulicz and later Kroenlein expressed the view that operation for acute, profuse gastric hemorrhage is more dangerous than expectant treatment and that operation should be postponed until the patient recovers from the great loss of blood. They believed that only the presence of a secondary anemia caused by repeated small hemorrhages was an absolute indication for operative interference. Twenty years ago I suggested early operation as the treatment of choice for hemorrhage from a chronic ulcer because such hemorrhage, coming from an eroded large artery at the base of a penetrating ulcer could be stopped permanently only in this manner. This proposal was rejected not only by internists but also by some surgeons, Clairmont, for instance. Singer was the only internist who believed that acute profuse hemorrhage was "the most surgical complication" of gastric ulcer. Poor results following conservative treatment gradually induced several surgeons, such as Friedemann, Haberer, Pannet and Petermann, to adopt surgical intervention in the treatment of bleeding ulcers. The subject was discussed at the Congress of the French Surgical Society in 1933 and the main speakers—Papin and Willmoth—advocated operation unless the bleeding stopped within 48 hours after blood transfusion. Gordon Taylor of the Middlesex Hospital in London reported a 21 per cent mortality after conservative treatment and was able to reduce the mortality to 9 per cent after he began operating early. Of 22 cases he lost only 2.

I have repeatedly demonstrated the falsity of the statement that the results following conservative treatment are superior to those following operative procedures. Such statements are usually based on comparisons of

not identical cases. All cases, including patients with slight hemorrhage were included in with the conservatively treated group, hence the mortality did not exceed 2 to 5 per cent. If only the patients with grave gastric hemorrhages causing fainting spells, with a hemoglobin index below 40 per cent and the erythrocyte count below $2\frac{1}{2}$ millions, are considered, the mortality rises from 3 per cent, as reported by Miller, of Philadelphia, to at least 11 to 25 per cent or more. Aikhen, from the London Hospital, reported 11 per cent mortality among his 255 cases of acute hemorrhage, while all 192 patients with only slight bleeding recovered, of 63 with grave hemorrhage 27, or 43 per cent, died. Of the conservatively treated 31 patients, 17, or 54.8 per cent, expired, of 11 cases in which in addition blood transfusion had been performed, 3, or 27.2 per cent, succumbed to the hemorrhage. Of 21 patients in whom after unsuccessful internal treatment late operation, chiefly a gastro enterostomy, had been performed, 7, or 33.3 per cent, expired. Chiesman, of St. Thomas Hospital in London, reported 25 per cent mortality in his series consisting of 191 patients with acute gastric hemorrhages. Of 129 patients who bled only 1 day, only 2 patients, or 1.5 per cent, died while of 62 cases bleeding 2 or more days, 46 patients, or 74 per cent, expired. At autopsy erosion of a large blood vessel, such as the left gastric or pancreaticoduodenal artery was found at the base of an ulcer penetrating into the pancreas in 45 instances. The age of the patient is very important. Of 11 patients younger than 40 years, 7, or 63 per cent, died, of 40 patients at the age of 40 to 60 years, 28, or 70 per cent, died. All 11 patients older than 60 years died in spite of internal therapy. Ross, of Melbourne, observed 58 per cent mortality in 45 cases with grave hemorrhage.

In the cases reported in the literature in which surgical treatment was used, operation

From the First Surgical Division of the Allgemeines Krankenhaus in Vienna

was usually performed only after internal treatment over a period of several days failed to stop the hemorrhage. In the majority of cases gastro enterostomy was performed although hemorrhage can almost never be stopped by such a procedure. The deaths resulting from severe anemia are not considered in the statistics of conservatively treated patients since these patients with continuing bleeding were finally subjected to operation and increased the operative mortality. Lynch of Montreal compares the mortality rates of his 31 patients conservatively treated which was 12.9 per cent with the operative mortality rate 42.8 per cent and draws the conclusion that the conservative treatment is superior to the surgical. He does not draw attention however to the fact that the operation was performed only in the late stages when all other attempts to stop hemorrhage proved futile.

It is impossible to compare the 2 groups of cases first because no internist restricts treatment solely to conservative measures but refers patients with persistent hemorrhage to the surgeon and second because the surgeon seldom has the opportunity to operate upon such patients in early stages of the disease. If comparisons are to be made only results after early operation performed during the first 24 to 48 hours and without preliminary attempt to treat them conservatively—should be considered. Of 22 cases Gordon Taylor had only 2 fatalities or 9 per cent. Ohani lost only 1 patient of pneumonia and 9 recovered.

In my experience the mortality rate after early operations averages 5.1 per cent of 7 patients having gastro enterostomies 1 expired and of 71 patients having gastric resection 3 died from 6 to 20 days after operation. My statistical material includes also cases in which patients were suffering with severe hemorrhages due to erosion of the pancreaticoduodenal artery. It is evident that it is much safer to operate immediately and to ligate a large eroded blood vessel than to perform a blood transfusion and see whether the patient continues bleeding or not.

Internists assert that hemorrhage as the cause of death is so rare that it should not be

considered as an indication for an operation. They claim that conservative treatment is never followed by a fatal outcome. This is true only if no large artery be eroded. Hemorrhage from a flat mucosal ulcer nearly always stops after conservative treatment or a blood transfusion and in such cases death is rare. Hemorrhage from a mucosal blood vessel in a callous ulcer may also be checked without operation, but this is not true if the bleeding originates in a large eroded artery outside the stomach or duodenum. In such cases the hemorrhage lasts many days and, according to Chiesman, the mortality rate after conservative treatment reaches 74 per cent. In his material of 46 fatal cases autopsy revealed erosion of a blood vessel in 45. A mortality rate of 74 per cent contradicts the statement that, with medical treatment, death from a hemorrhage is rare. I have observed more than 10 patients who succumbed to acute gastric hemorrhage after they had been unsuccessfully treated in a conservative manner. In 2 cases I was not able to operate because in one resection of the cecum had been done for tuberculosis and in the other appendectomy for a perforated appendix preceded the hemorrhage and in neither could resection of the stomach be considered because of the danger of causing peritonitis from suppurating wounds. The second mentioned patient died from a hemorrhage despite the fact that three blood transfusions were given. Postmortem examination revealed in this patient, who had suffered for 10 years with an old duodenal ulcer erosion of a large blood vessel.

Grave hemorrhages start usually in duodenal ulcers although Kalk claims that in his conservatively treated patients the bleeding occurred more frequently from gastric ulcer and was more dangerous than a hemorrhage from a duodenal ulcer.

It has been stated that the diagnosis of a bleeding ulcer is very difficult because fatal hemorrhages may have an entirely different source. According to a generally accepted principle the attention of the physician should be focused not on the exceptions but on the most frequent conditions. According to Bulmer in over 90 per cent of all acute gastric

hemorrhages, chronic ulcers were found and therefore ulcers should always be suspected even if very few complaints are found in the history and the x ray findings are negative. In doubtful cases, exploratory laparotomy under local anesthesia is much safer than expectant treatment after blood transfusion. If a gastric ulcer cannot be diagnosed from external inspection, gastrotomy should be performed and the mucosa carefully palpated in order to locate, if present, a penetrating ulcer on the posterior wall of the duodenum, for such an ulcer is particularly dangerous. Exploratory laparotomy may reveal other causes of an acute gastric hemorrhage. In a 60 year old man, in addition to a grave liver cirrhosis, I found a callous ulcer of the lesser curvature, which had not previously been recognized. This patient was cured by a typical resection, without operation the patient would have died from a hemorrhage from an eroded vein. Hemorrhage from a dilated esophageal varicosity caused by liver cirrhosis cannot be stopped by operation, but exploratory laparotomy performed under local anesthesia is harmless in such cases and makes possible the exclusion of hemorrhage from a callous ulcer. If exploration discloses bleeding from a flat ulcer and erosive gastritis, which is seldom the case, the typical gastric resection removes the inflamed mucosa of the antrum so that not only the hemorrhage ceases but a permanent cure is obtained. Neugebauer reported several such cases. I performed late operation for acute hemorrhage in 3 cases in which gastritis was found to be the cause of grave hemorrhage of several days' duration. All 3 patients were permanently cured. Cancer of the stomach very rarely causes profuse hemorrhage. I have performed gastric resection in 710 cases of carcinoma and in only 3 were acute hemorrhages observed before the operation. Once I saw a severe hemorrhage from an eroded cystic artery. The erosion was caused by an ulcer produced by a large gall stone, at operation the stomach was found to be empty but the common duct and the small and large intestines were filled with blood. Cholecystectomy was preceded and followed by a blood transfusion and the patient was saved.

Internists also claim that, even if an ulcer is found at operation, the hemorrhage cannot be permanently stopped if the bleeding originated in an eroded blood vessel. The surgical results contradict this statement, however. The various methods of stopping the hemorrhage which the surgeon has at his disposal will be discussed later. If a large artery is eroded, the perforation, the size of a pinhead, is usually closed by a thrombus after the blood pressure falls as a result of collapse. The bleeding temporarily stops but recurs after 2 to 3 days when the thrombus has been digested by hydrochloric acid. In such cases the mortality rate after conservative treatment reaches 74 per cent according to Chiesman, and at autopsy an eroded artery can be found at the base of a penetrating ulcer. If early operation is performed in such cases a few hours after the onset of the bleeding, as soon as the patient recovers from the collapse, the entire base of the ulcer is found covered with blood coagulum which closes the small perforation in the artery, after its removal the blood spurts from the blood vessel. Cessation of the hemorrhage can be accomplished relatively easily by double ligation of the exposed artery. In 8 instances I was able to ligate the eroded pancreaticoduodenal artery successfully and to perform a typical resection. However, if the operation is performed late after repeated grave hemorrhages, the hemorrhage can also be stopped, but the severe anemia which follows may be fatal. Even in the presence of hemorrhage from a large artery, death does not necessarily take place immediately, as may be seen from the fact that, according to Tuffier, hemorrhage from a splenic artery may last 24 to 48 hours and even as long as 7 days. Erosion of the left ventricle is known to have caused hemorrhages of 10 days' duration in 2 patients with ulcers penetrating the diaphragms. The cases were reported by Brenner and Oser. It follows that there is sufficient time to prepare the patient and to perform an operation even in the presence of an erosion of a large blood vessel.

The diagnosis of a gastric hemorrhage from a chronic ulcer can usually be made from the history and the roentgenological findings be-

cause according to Kalk massive hemorrhages without previous symptoms are rare and in the majority of the cases the bleeding comes from chronic ulcers. This point is of great importance in deciding whether or not to operate. In doubtful cases consultation with an experienced internist is to be recommended.

The indications for operation depend on whether the hemorrhage is the first symptom or whether it was preceded by serious complaints. Tidy asserted that I operate in each case of gastric hemorrhage even though the bleeding is slight and no other complaints are present. If there is no hemorrhage gastric operation is not indicated. I recommend expectant treatment under the supervision of an experienced internist and if necessary such treatment may be supported by blood transfusion. Such patients are usually young and most of them are women. I have never observed a fatal case in this group since no callous or penetrating ulcers have been noticed in this material. Only in old people who have large ulcers but have no serious symptoms is an exploratory laparotomy under local anesthesia safer than expectant treatment.

If chronic ulcer has been diagnosed clinically and roentgenologically and the hemorrhage is grave I advise immediate operation because the results of early operation are nearly as good as those of a common gastric resection. I recommended early operation 16 years ago because the results were very good. This statement has been confirmed by Gordon Taylor. Early operation avoids not only the danger of secondary perforation but also the harmful effects of a prolonged anemia resulting from repeated hemorrhages. Grave damage to the liver, kidneys, heart, brain and other viscera may interfere with the beneficial effect of a postponed operation. Furthermore death from successive hemorrhages to be feared when continuous pain has preceded the hemorrhage can be avoided. Such continuous pains usually point to hemorrhage from a penetrating ulcer. In such cases the bleeding may arise from a small artery in the mucosa of the margin of an ulcer or from a large artery at the base of

the ulcer and in view of the fact that the location of the source of the bleeding cannot be established without operation, I advocate early surgical interference and avoid, in a majority of cases, a blood transfusion even if the anemia is very pronounced, e.g., if hemoglobin is only 30 per cent and erythrocytes number 2,000,000.

If the diagnosis of hemorrhage from a chronic ulcer is doubtful I recommend exploratory laparotomy especially in elderly patients. Usually in such instances a previously silent ulcer is found and resection is performed. If in such cases instead of operation blood transfusion is performed as was recommended in 1933 at the Congress of the French Surgical Society, no great benefit is derived if an erosion of a large artery is present because the hemostatic effect of a transfusion has not yet been definitely demonstrated. Reschke sent out a questionnaire to the Berlin hospitals and found that 50 per cent of patients treated with a blood transfusion died. Possibly continuous venoclisis with citrated blood as advocated by Marriott and Keckwick of the Middlesex Hospital is more successful in such instances.

If after unsuccessful conservative treatment patients with recurrent hemorrhages are sent in for operation I advise expectant treatment if it is probable that the hemorrhage has ceased. I have assumed this attitude because the anemia which is responsible for damage to vital internal organs may interfere with the operative results and because the untoward effects of anemia may be intensified by operation. At autopsy upon such non-operated upon patients no blood is shown in the intestines and the eroded blood vessel is temporarily occluded by a thrombus. If hemorrhage does not stop spontaneously operation with ligation of the bleeding vessels is indicated in spite of the seriousness of such a procedure.

The main purpose of operative treatment in the presence of acute gastric hemorrhage is reliable hemostasis, the question of permanent cure of the ulcer being of a secondary importance. For the purpose of hemostasis a gastroenterostomy is performed in cases with a bleeding duodenal ulcer it was per-

formed, combined with ligation of the pylorus by many surgeons, but it should be remembered that a gastro enterostomy has only an indirect hemostatic effect by causing a continuous emptying of the stomach through the new stoma and facilitating in this manner the permanent contractions of the stomach. It follows that gastro enterostomy may be effective only in hemorrhages from a flat ulcer but never if bleeding comes from an ulcer penetrating into the pancreas. While an assistant of Hochenegg, I had to perform a gastro enterostomy, because resection of the ulcer was forbidden. Two patients died from a continuation of the hemorrhage and at the autopsy in one case an eroded pancreatic artery and in the second case an eroded splenic artery was found.

If at operation a gastric ulcer penetrating into the pancreas is found, the stomach is separated from the base of the ulcer and the bleeding vessel is ligated. It depends on the general condition of the patient whether the margins of the ulcer are simply excised and the stomach is sutured or a typical gastric resection is performed. If a duodenal ulcer penetrating into the pancreas is not resectable on account of its position and extent, I do not perform resection for exclusion of the ulcer but substitute for it a simple ligation of the pylorus combined with a posterior gastro enterostomy. Compression is applied to the duodenal region by means of a large tampon placed directly over the duodenum so that it causes a protrusion of the anterior abdominal wall. A tight bandage presses this tampon against the duodenum and the posterior abdominal wall. Thus direct pressure produces a hemostatic effect. After 24 hours the pressure must be released by loosening the bandages to avoid damage to the pancreas. I used this method in 11 cases, in 2, early operation was performed and the patients recovered while of the 9 patients in whom the operation was performed later, 3 died of anemia. The hemostasis was perfect in the first patient, who died 10 hours after operation. Autopsy showed no blood in the small intestines although they were filled with blood at the time of the operation. The second patient succumbed after 3 days from pulmonary em-

bolism and the third patient died after 4 weeks from an acute psychosis. This simple method is efficient when direct hemostasis by resection or ligation of the bleeding vessel is impossible.

Excision of a bleeding gastric ulcer can always be performed and has a perfect hemostatic effect. If, however, the condition of the patient allows it, instead of excision a typical gastric resection should be done thus guaranteeing a permanent cure. Although this operation is generally considered to be dangerous, it is well tolerated by exsanguinated patients. The mortality rate depends upon the duration of the grave hemorrhage. If early operation is performed within the first 24 to 48 hours damage to the parenchymatous organs by the anemia may still not have occurred and the results are good even if the hemorrhage has been severe or the patient is old. Of 78 cases in my series only 4, or 5.1 per cent, died. While in the group of 7 gastro enterostomies 1 patient succumbed to a continuous hemorrhage from the pancreatic artery, of 71 cases with gastric resection 3 patients or 4.2 per cent, died.

An 80 year old patient had had gastric complaints for 40 years. Later the pains became more intense and the patient had been vomiting repeatedly and had lost 34 kilograms. On account of the presence of a complete pyloric stenosis the patient was scheduled for a gastro enterostomy but the night before the operation he collapsed. The following morning his pulse was 130 of poor quality and the stomach was completely filled with fluid. Aspiration of gastric contents showed blood and therefore immediate operation was decided and was performed under local anesthesia. A 0.25 per cent novocain solution being used. Paracentesis of the exposed enormously dilated stomach furnished 4 liters of blood and gastric juice. A large crillous ulcer reaching the pancreas was found on the lesser curvature and another ulcer in the pyloric region. A resection of the duodenum and one half of the stomach and a Hofmeister Finsterer's anastomosis were performed. The pulse immediately after the operation was 136 the following day 100 and the third day 80. The patient felt perfectly well and on the third postoperative day was out of bed, had a normal bowel movement and was passing flatus. Eight days after the operation he suddenly developed a chill, his temperature rose to 102.2 degrees, and on the tenth day he died from bilateral pneumonia.

A 48 year old man had been suffering from stomach complaints for 6 years and was repeatedly treated for a duodenal ulcer. Three months before his entry into the hospital he developed a grave hemorrhage and fainted and after that he was practically symptom free. Three days before admission he developed influenza with fever and 4 days later vomited blood and passed bloody stools. The patient fainted repeatedly and 1 hour after the onset of the hemorrhage was brought in an automobile to Vienna.

over a distance of 40 kilometers. The blood count showed 2,300,000 erythrocytes, hemoglobin 10 per cent, pulse 126 and of poor quality. An immediate operation was performed under splanchnic anesthesia with 0.25 per cent novocain. One ulcer was found on the anterior wall of the duodenum ready to perforate another ulcer penetrating into the pancreas was to be acted on the posterior duodenal wall. The stomach was empty but the entire small and large intestines were filled with blood. Resection of the ulcer was performed and the ulcer base was left *in situ*. After the duodenum had been separated from the ulcer base a severe hemorrhage developed from the eroded pancreaticoduodenal artery which was ligated and the duodenum closed. 1/3 of the stomach were resected and Holmeister-Einarter anastomosis was performed. One drain was inserted. No abdominal complications developed but a grave febrile bronchitis became transformed into a bilateral pneumonia. The patient expired 3 weeks after the operation from the influenza and pneumonia.

A woman 46 years of age was in perfect health until 3 weeks before the admission to the hospital when she developed pain and vomiting on account of which she was admitted to the medical department of the General Hospital in Vienna. At that time the gastric acidity was 53/78 blood was present in the stools. Two weeks later she suddenly vomited a large amount of bright red blood and collapsed. Forty-five minutes later she vomited again and the frequency of the pulse rose to 120/130. During the transfer to the surgical department she again vomited bright red blood and collapsed. Examination in the operating room showed a mentally confused, restless patient with a hurried pulse 160 and hardly palpable. An immediate operation was performed under local anesthesia—0.25 per cent novocain solution. During the operation a transfusion of 750 cubic centimeters of blood was given. The stomach and the small and large intestines were completely filled with blood. A duodenal ulcer penetrating into the pancreas was found and the duodenum was separated from the base of the ulcer which was covered with blood coagulum. As soon as the latter was removed bright red blood spurting from a laterally eroded pancreaticoduodenal artery. The diameter of the ulcer base were 2.5 by 1.5 by 0.5 centimeter. The artery was ligated the duodenum was closed 2/3 of the stomach was resected an end-to-side Holmeister-Einarter anastomosis was performed and a drain was placed at the base of the ulcer. The following day the pulse was 104 n. vt. 90. As the patient vomited black mass es gastric lavage was given on the first postoperative day. Three days after operation the patient developed bilateral pneumonia and she expired on the sixth day. The autopsy revealed a diffuse suppurative bronchitis a confluent bronchopneumonia of both lower lobes and a bilateral suppurative pleurisy. There were signs of a grave secondary anemia. The lacerated blood vessel was the main trunk of the pancreaticoduodenal artery. The anastomosis was in perfect shape. As the patient was transferred in great haste from the medical to the surgical department located in another building he probably caught a cold with the resulting bilateral pneumonia which the weakened organism was not able to overcome.

The results from early operation were much better than those from conservative treatment although the ages of 12 patients ranged from 60 to 69 years. As in 8 cases erosion of the main trunk of the pancreaticoduodenal artery was present and under such circumstances only an operation could have stopped

the bleeding probably of the 71 cases of resection at least 12 to 20 per cent would have died, had they been treated conservatively. Operation, however, was followed by a mortality of 4.2 per cent. In view of such experiences I continue to advocate early operation.

The internist Umber is opposed to early operation in the presence of acute hemorrhage and cites a 57 year old woman with an ulcer penetrating to the liver and the pancreas which was responsible for a grave hemorrhage. In view of the fact that the general condition of the patient was poor and that she had only 30 per cent hemoglobin and 1,500,000 erythrocytes, the surgeon declined an early operation. A temporary cessation of bleeding followed a blood transfusion but the hemorrhage recurred on the seventh day and on the eleventh day the hemoglobin contents were only 19 per cent pulse 160 patient, unconscious. An operation was decided upon as a last resort but the patient expired in course of the preliminary blood transfusion. The autopsy showed a large gastric ulcer penetrating into the liver and the pancreas and an erosion of 2 large arteries. Umber concludes that the surgeon was justified in refusing to perform an early operation as recommended by me because such procedure undoubtedly would have stopped the fatal outcome. Based on my experience I believe that this case demonstrates the dangers of delay. If early operation under local anesthesia is performed in such a case and is preceded by blood transfusion and if according to Reschke's suggestion a large amount of blood, e.g., 1,500 cubic centimeters of blood be used, it would be expected that the hemorrhage would be stopped as successfully as in the 6 cases in which I operated and in which erosion of the pancreaticoduodenal artery had taken place. After prolonged anemia has damaged all the organs including the brain, no results can be expected from operation, no matter how much blood has been transfused.

The results of late operation are relatively poor even if direct hemostasis can be accomplished. Of 7 cases in which gastroenterotomy was performed 3 patients died. Such poor results are due to the continuation of

the bleeding from the penetrating ulcer. Even direct hemostasis is frequently unsuccessful because no recession of the degenerative changes in the internal organs caused by the anemia can be expected.

In 4 instances the ulcer was excised and 2 patients died from anemia. Of 63 resections 17, or 26.9 per cent, died. It must be stated that in 4 instances death was not attributable to the hemorrhage or to the operation, 1 patient died from a recurrence of dysentery, 1 from uremia, 1 from septicemia following gangrenous appendicitis, and 1 from diabetic coma. In 2 cases perforation of the ulcer and peritonitis developed, such complications could have been avoided by early operation. When these 6 cases were deducted, the mortality still remained as high as 19.2 per cent. In the majority of the fatal cases the grave damage caused by anemia was responsible for death. The operation revealed erosion of a large artery outside of the stomach wall. The majority of the fatal cases were observed before 1924 when a blood transfusion was not yet used. It is questionable, however, whether blood transfusion could have saved those cases.

Poor results after delayed operation do not militate against the operative procedure because sometimes the patient can be saved.

Umber reports a 23 year old patient who in spite of 5 blood transfusions had recurrent hemorrhages until the hemoglobin fell to 26 per cent and the red count did not exceed 1,200,000, on the twenty eighth day of bleeding the patient was unconscious and delirious and was operated on as Umber advised. At operation a duodenal ulcer penetrating in to the pancreas, with an erosion of the pancreaticoduodenal artery was found. One blood transfusion was given before and two after the operation which consisted of a Billroth II gastric resection. The patient recovered.

In my series of cases there were 6 among the late operations in which in spite of the fact that the pancreaticoduodenal artery was eroded, gastric resection produced a cure.

The relatively poor results after delayed operation are still superior to those of purely conservative treatment according to Chies-

man, the mortality in cases in which the bleeding lasted more than 2 days was not 3 per cent but 74 per cent. Gordon Taylor, of the Middlesex Hospital, reports even a mortality of 76 per cent with medical treatment. Therefore I believe that no surgeon is privileged to refuse operation to a patient unsuccessfully treated by an internist.

The type of anesthesia used is of greatest importance in operations for acute hemorrhage, especially in delayed operations. Ether anesthesia must be avoided under all circumstances because, according to Crile's investigations reported in his book entitled *Surgical Shock and Shockless Operations Through Anoci-Association*, ether produces grave damage to the parenchymatous organs, especially the liver, kidneys, and brain. While normal organs easily overcome such harmful effects, organs damaged by anemia may be fatally affected. For these reasons I perform all operations for acute hemorrhage under local anesthesia, avoiding if possible splanchnic anesthesia because the latter has a depressor effect. Careful regional anesthesia of the abdominal wall is followed by an anesthesia of the mesentery, using a 0.25 per cent novocain solution. Great caution should be exercised in the use of morphine or pantopon before or after the operation, because even the usual doses may produce a paralysis of the respiratory center damaged by anemia, as seen by the author in 2 cases. If morphine is desired, 0.01 to 0.015 of the drug combined with 0.00025 atropine is given before the operation. In the presence of grave collapse repeated coramin injections are given in the course of the operation, in addition to it inhalations of ether are given for stimulating purposes, provided no bronchitis is present. For this purpose the total amount of ether given with the open method does not exceed 10 to 20 cubic centimeters. Great attention must be paid to after treatment, especially in old people, deep respiration and good expectoration are necessary to avoid a retention pneumonia, if a bronchitis is present.

While a large percentage of conservatively treated patients remains uncured and the patients must be operated on later, at least 90 per cent can be relieved of all their symp-

toms after resection of two thirds of the stomach. In my material all 114 patients were permanently cured by resection.

The surgical treatment of an acute gastric hemorrhage requires sufficient experience not only in gastric surgery but also in the evaluation of the case. Therefore, such operations should be performed in large hospitals not by young assistants but by the head of the department or one of his older associates in order to keep the mortality as low as possible without refusing operation to anyone who shows an absolute indication.

Acute profuse gastric hemorrhage should not be confused with grave secondary anemia following repeated gastric hemorrhages, the latter has been considered for a long time as an absolute indication for operation. Such hemorrhages are not seen so often as they used to be. I operated upon 54 patients with secondary anemia; the number of erythrocytes ranged from 1,500,000 to 2,500,000 and the hemoglobin contents from 20 to 30 per cent. Before the World War I used only gastro-enterostomy. Of 5 cases 1 expired on the sixth day from an erosion of the splenic artery. After the War resection has been used almost exclusively. This operation has given us good results even without transfusion and it has always been performed under local anesthesia. Of 49 resections death occurred in 2 i. e. 4 per cent.

Gordon Taylor closes his paper on the treatment of acute gastric hemorrhages as follows: "Insurer's first 48 hours is still the optimum period for surgical attack in hematemesis and the golden age of gastric surgery

will have been attained only when all cases of hemorrhage from chronic ulcer come to operation within that space of time."

I wish to express my appreciation to Dr. Joseph K. Narat, Chicago, Illinois, for his translation of this paper from German into English.

BIBLIOGRAPHY

1. MITTEN R. S. *Lancet* 1934 1 839
2. BRENNER *Wien med Wehnschr* 1881 p 1310
3. CHIESMAN W. F. *Lancet* 1932 11 722
4. CLAIRMONT *Wien klin Wehnschr* 1918 p 631
5. CRILE C. Surgical Shock and Shockless Operation through Anest. Association. Philadelphia and London W. B. Saunders Co. 1911
6. FINSTERER H. *Wien klin Wehnschr* 1918 No 19 1931 Nos 36-38 *Deutsch Ztschr f Chir* 1920 158 44 *Klin Wehnschr* 1922 1 1253 *Rev de chir* 1933 41 673 *Cong franç de chir* 1933 p 993 *Lancet* 1936 2 303
7. FRIEDENMANN M. *Muenchen med Wehnschr* 1924 71 1603 *Zentralbl f Chir* 1917 54 2150
8. GORDON TAYLOR G. *Lancet* 1934 1 572 1935 2 811
9. HABERER H. *Deutsche Ztschr f Chir* 1927 200 212
10. KALK H. *Deutsche med Wehnschr* 1936 62 1202
11. KROENLITZ *Arch f klin Chir* 1906 79 644
12. LYNN R. *Canadian M Ass J* 1927 17 677
13. MARRIOT H. L. and KECKWICK A. *Lancet* 1935 1 977
14. MIKULICZ Mittel a. d. Grenzgeb d. Med u. Chir. Vol. 2 1897
15. MILLER T. G. *Pennsylvania M J* 1929 31 677
16. OLIANT *Cong français de chir* 1933 p 1006
17. OSER *Wien med Blätter* 1880 p 1315
18. LANNETT C. A. *Brit M J* 1929 1 623 *Lancet* 1934 1 574
19. PAPP *Cong français de chir* 1933 p 801
20. PETERMANN *Arch f klin Chir* 1925 135 493 *Zentralbl f Chir* 1926 53 2591
21. RESCHKE I. *Deutsche med Wehnschr* 1933 61 1263
22. SINGER *Wien klin Wehnschr* 1918 21 599 *Med Klin* 1918 14 1131
23. TUDY *Lancet* 1935 11 915
24. UNBER I. *Deutsche med Wehnschr* 1935 61 1263
25. WILLMOTH *Cong français de chir* 1933 p 795

MALIGNANT TUMORS OF THE SMALL INTESTINE

A Study of Their Incidence and Diagnostic Characteristics

FREDERICK G. MEDINGER, M.D., Wrentham, Massachusetts

THE subject of intestinal malignancies is always of vital interest malignancies of the colon and rectum because of their great frequency, malignancies of the small intestine because of their rarity. Ewing estimates the comparative incidence of malignancy in the large and small intestines to be 97.5 per cent and 2.5 per cent respectively. The incidence of intestinal carcinoma in order of frequency according to location is rectum, cecum and appendix, sigmoid, colon, and small intestine. Kaufmann and others state that over 60 per cent of intestinal malignancies arise in the rectum. In 1930, Schofield found only 36 cases of small intestinal carcinoma in a total of 140,000 autopsies. Similarly, from a series of more than 350,000 autopsies Eger reported in 1933 an incidence of 30 duodenal carcinomas per 100,000 patients.

Of the malignant tumors of the small intestine, carcinomas appear to outnumber the sarcomas. In a review of the literature, one is impressed by the tendency of authors to classify and describe only carcinomas and to place sarcomas with lymphomatous tumors in a general group of other malignant tumors of the small intestine. The comparative incidence of the two groups of malignant neoplasms has seldom been recorded. However, Brill from 17,000 autopsies at Guy's Hospital, London, collected 10 cases and of these 4 were carcinoma and 6 sarcoma. In Rastford's series of 34 cases, there were 20 carcinomas and 14 sarcomas. He concludes that the tumors of the small intestine rank in order of frequency (1) carcinomas, (2) adenomas and sarcomas, (3) lipomas and tumors of chronic inflammatory origin, and finally, the most uncommon fibromas, myomas, carcinoids, hemangiomas, cysts, and endotheliomas.

It is interesting to note the incidence of malignancies of the small intestine in the pathological material of the New England Deaconess and Palmer Memorial Hospitals during the period from January, 1927, to January, 1939. During this 12 year period 918 primary malignancies were found in a total of 1456 postmortem examinations. In brief, in 63.0 per cent of autopsies malignancy presented. There were approximately 41,000 surgical specimens and in 20 per cent of these the primary diagnosis was malignancy. A review of the same series shows only 10 cases that came to autopsy with small intestinal malignancy, or an incidence for all autopsies of 0.69 per cent and for all malignancies seen at postmortem examination of 1.09 per cent. The surgical material shows 12 cases, an incidence for small intestinal malignancy of 0.03 per cent of the total specimens and 0.15 per cent of total malignancies removed surgically. Since a large part of the service of the New England Deaconess and Palmer Memorial Hospitals is devoted to the treatment of cancer, these findings are not comparable with those given by Eger and others (15, 16) from several general hospital records.

The observed location of the tumors in these 22 patients is in disagreement with the statements of Ewing and Bland-Sutton that the jejunum is least frequently the site of malignant growth and that the nearer one approaches the beginning and end of the small intestine the more frequently one finds cancer, for, of the total, 12 occurred in the jejunum, 7 in the ileum, and 3 in the duodenum. However, it is only fair to add that with 22 cases there is considerable chance error of distribution to account for this difference. In 22 cases of small intestinal malignancy, Judd similarly found 11 in the jejunum, 6 in the ileum, and 5 in the duodenum. From a small series of cases in the literature, Deaver and

TABLE I—LOCATION OF MALIGNANCY IN SMALL INTESTINE

	Duo- de-um	Je- ju-um	I-leum	Total
Benign	7	0	1	8
Adenomas	3	1	6	10
Leiomyosarcomas	8	7	16	31
Lymphoma	0			3
Other		1	0	1
Total	8	8	23	39
Benign	7	0	1	8
Adenomas	3	1	6	10
Leiomyosarcomas	8	7	16	31
Lymphoma	0			3
Other		1	0	1
Total	8	8	23	39

*O. E. H. F. D. C. K.

Ravdin found a relative distribution of malignancy of the duodenum and that of jejunum and ileum as 47.8 per cent to 52.2 per cent and 66 per cent of those in the duodenum occurred in the second portion. On analysis of 134 cases including the author's series of small intestinal malignancy reported in the literature (Table I) the distribution according to location follows: duodenum, 51 cases; jejunum, 39 cases; ileum, 44 cases. It seems apparent therefore that the duodenum and ileum are somewhat more prone to develop malignant growths than the jejunum. However, of the small intestinal cancers, cancer of the jejunum is not rare.

In the author's series the total of 22 cases represents 16 primary carcinomas and 6 primary sarcomas, 2 cases of primary lymphoblastoma being excluded. An impression that sarcoma occurs most frequently in the terminal jejunum and ileum and carcinoma usually in the duodenum and jejunum is borne out by the finding of 5 of the 6 sarcomas in the ileum and 14 of the 16 carcinomas in the duodenum and jejunum. One sarcoma occurred in the lower jejunum and 2 carcinomas in the ileum. The location of malignancies in the author's series (Table II) corresponds to the observations of Lewis and Morse and of Kiefer that the duodenum and jejunum are more likely to undergo carcinomatous change than the ileum and that sarcoma occurs more frequently in the ileum than in any other part of the small

TABLE II—CLASSIFICATION OF MALIGNANCIES IN SMALL INTESTINE (AUTHOR'S SERIES)

Classification	Duodenum		Jejunum		Ileum		Total
	Adenoma	Sarcoma	Adenoma	Sarcoma	Adenoma	Sarcoma	
Adenocarcinoma	3	0			4	1	8
Carcinoma simplex	0	0	0	1		0	1
Malignant adenoma	3	0	1	3	0		7
Leiomyosarcoma	0	0	1	0	3	3	7
Total	3	0	1	4	7	4	19

*These figures represent adenocarcinoma, carcinoma simplex, malignant adenoma, respectively reported by D. Everett D. Kiefer.

**These figures represent leiomyosarcoma, respectively reported by D. R. B. Cattell.

intestine. It is generally held that sarcomas occur more frequently in the ileum due to the greater abundance of lymphoid tissue in this segment of the intestine. However, among the cases of sarcoma recorded in the literature there is no record of histological classification of the sarcoma. The 1 case of sarcoma reported by Cattell and the 6 cases reported by the author all prove to be the leiomyosarcoma type.

Two patients in this series presented multiple malignancies; in addition, a third patient showed a carcinoma of the appendix in association with a leiomyosarcoma of the ileum.

Calculated at the time of autopsy or operation the average age incidence for this series was 54 years for the carcinoma group, 56 years, and for the sarcoma group 47 years. The youngest patient presenting at autopsy a leiomyosarcoma of the ileum was a male of 31 years. There were 9 males and 13 females.

Although malignancies of the small intestine may occur as part of a local or generalized polyposis, Ewing states that they are seen usually as a localized growth. In none of the patients of this group who were treated surgically or who came to autopsy was there an associated polyposis recorded. Like those in the colon, these tumors tend to be stenosing or polypoid in form, the malignant adenomas and mucinous adenocarcinomas assuming the polypoid form, growing extensively into the bowel lumen and with delayed surface ulceration often producing obstruction. The scar

rhous carcinomas, or carcinoma simplex, and sarcomas tend to be annular, producing obstruction by constriction of the intestinal lumen. Because of the more expansive nature of the sarcomas, the mesenteric nodes are reported by Raiford to be more frequently involved by tumor. Several small series of cases of small intestinal malignancy that came to autopsy show metastases present in one quarter to one third of the patients and involve chiefly the mesentery, liver, lungs, and peritoneum. Craig, reporting a series of 26 cases from the Mayo Clinic, demonstrated that 36 per cent of the patients showed mesenteric lymph node involvement and according to him neither the size of the growth nor the duration of the symptoms is a reliable index of lymphatic involvement. Of the author's series, 7 patients presented metastases. Three of the 10 patients who came to autopsy showed metastases to the mesenteric nodes and viscera. Three surgical specimens showed metastases in the adjacent mesenteric lymph nodes. A seventh patient with adenocarcinoma and negative lymph nodes showed generalized carcinomatosis 2 years later at re-exploration.

The clinical picture of small intestinal malignancy is usually not clear cut and varies widely. In general, Schofield, Brill, Judd, Deaver and Ravdin, and others, conclude that primary carcinoma of the duodenum arising in the first and third portions usually obstructs the bowel. If the tumor occurs in the first part of the duodenum, symptoms are more often acute in onset and simulate pyloric carcinoma with obstruction. Primary carcinoma of the second portion, usually arising in or about the papilla of Vater, seldom produces intestinal obstruction. Biliary obstruction with resultant painless jaundice, clay colored stools, choloria, and associated constitutional complaints, is the train of symptoms most often seen. However, a few patients with perampullary carcinoma first present themselves with intestinal obstruction alone. In connection with obstructing malignancies of the third portion of the duodenum, Deaver calls attention to the profuse vomitus containing bile and the pancreatic enzyme, trypsin.

Raiford, Johnson, and others cite malignancy of the lower small intestine as producing symptoms most commonly of partial or complete obstruction due either to pressure and gradual encroachment of the lumen, or to intussusception. There is a small group of tumors, growing away from the intestinal lumen into the free peritoneal cavity, producing no mechanical obstruction and merely the constitutional symptoms of malaise, loss of weight, anemia, and the like. Malignant tumors of the jejunum and ileum are more prone to produce intestinal intussusception. This occurred in 23 per cent of the tumors of the jejunum reported by Raiford and in 30 per cent of cases reported by Staemmler. The history of sudden onset of sharp pain and vomiting followed by bloody mucus in the stool, abdominal distention, and shock is the usual picture of intussusception associated with tumor. Raiford states that palpation of a mass is the most constant and reliable of the physical signs.

Although absence of free hydrochloric acid in gastric content and presence of occult blood in the stools are mentioned as frequent findings, these are not constant and obviously not specific for the diagnosis of small intestinal malignancy. Similarly, pain, nausea, vomiting, distention, palpable mass, and anemia may occur with any intestinal malignancy. The roentgenogram is generally recognized as the best positive means of diagnosis but is not infallible *per se*. Mills, in his classical paper on small intestinal states, concludes that, "any organic process involving the small intestinal wall, either primarily or secondarily, will modify the x-ray shadow of the content of the part involved and thus render direct diagnostic evidence of its presence." However, the roentgenologist is seldom able to diagnose more than the presence of an organic lesion in the small intestine and in about half of the proved cases x-ray evidence was negative. Important roentgenographic evidence supporting the diagnosis is (1) dilatation of the stomach or small intestine with barium retention, (2) filling defect in the small intestine, (3) point of intestinal constriction as in partial obstruction, and (4) dense shadow. The amount of gas, fluid, and distention seen

roentgenographically will depend on the level of the obstructing lesion and the degree of obstruction.

Lesions simulating carcinoma of the small intestine roentgenographically are ulcer polyp benign tumors diverticulum tumors and cysts of the head of the pancreas, pancreatitis and retroperitoneal inflammatory or neoplastic masses. If a defect is present, its character may be of help. A sharp marginal outline with the defect suggests a tumor within the intestinal lumen while a wide sweeping defect is most often produced by the pressure of extrinsic pathology.⁴

ANALYSIS OF SERIES

In the author's series of 22 cases of malignant tumors of the small intestine, there were 3 patients with duodenal carcinoma arising at the papilla of Vater presenting in common jaundice. One of these patients presenting in addition recurrent attacks of colic like pain at autopsy showed stones impacted in the common bile duct just proximal to the tumor and it is tempting to speculate whether the duct stones or the cancer were the primary disease process. If it could be supposed that the stones antedated the formation of the cancer by several years there are those who would cite repeated trauma as an important etiological factor in the origin of the malignancy. Two other patients presented typical histories of progressive painless jaundice of an obstructive type with clay colored stools and choluria.

Most cases of painless jaundice are due to an infectious or degenerative process of the liver or to carcinoma of the head of the pancreas. A valuable diagnostic measure for obstructive painless jaundice is Courvoisier's law. In the presence of painless jaundice a distended gall bladder palpable through the abdominal wall points to an obstruction due to cancer at 1 of 3 sites: head of the pancreas, papilla of Vater or common duct distal to the point where the cystic duct enters the common duct.

The outstanding complaints presented by the 19 patients with jejunal and ileac cancers were those of intestinal obstruction of an

acute or chronic nature. Thirteen of the 19 patients entered the hospital with the chief complaint of abdominal pain and vomiting. In these patients the pain varied in intensity from the vague intermittent abdominal distress to the severe persistent abdominal colic. Abdominal distention, flatulence, and eructation were often associated with the bouts of abdominal pain. It is significant that in no patient was there a remission of vomiting after onset. The duration of symptoms varied from several hours, as seen in acute intestinal obstruction up to 2 years.

Of the 19 patients there were 9 presenting generalized complaints of weakness, fever, loss of weight and anemia. In 3 patients these were the only presenting symptoms. It is significant that loss of weight was seen in only 4 of the 19 patients for one would expect, with chronic intestinal obstruction and toxemia as seen in the majority of these patients, many more would have complained of weight loss.

Of note is the finding of rectal complaints in 7 of these patients. The symptoms included constipation, gross blood, diarrhea and pencil like stools. Change of bowel habit was a presenting complaint in 3 of these patients and proved of great aid in localizing pathology in the gastro intestinal tract. The change of bowel habit or rectal bleeding as seen with cancer of the rectum, colon, and stomach is well known. Melena is cited by all observers as being an important finding with small intestinal malignancy. In 15 of our 22 cases there was no history of gross bleeding and no studies for microscopic blood. In 7 patients there was evidence of bleeding, 4 patients presented a history of gross bleeding or tarry stools and 3 patients studied for occult blood gave strongly positive reactions. It is therefore to be recommended that any patient with change of bowel habit or melena in whom studies have eliminated any pathology in the esophagus, stomach, colon, and rectum should be thoroughly investigated to rule out malignancy of the small intestine.

In 12 of the 22 patients an abdominal mass was palpable on physical examination—in 1 of the 3 duodenal cases, in 5 of the 12 jejunal cases and in 6 of the 7 ileac cases. The experi-

ence with this group of cases does not coincide with that of Raiford that in the malignancies of the jejunum and ileum intussusception of the carcinomatous mass occurs in about one fourth of the patients, for of the total, none showed intussusception at the time of operation.

The clinical x ray findings in this series confirm the statement of others that a careful gastro intestinal series with special study of the small intestines is of great aid in making a presumptive diagnosis of small intestinal malignancy. Twelve of the 22 patients received a gastro intestinal series previous to operation. In 8 of the patients there were positive findings of either intestinal dilatation with barium retention (6 cases) or filling defect (2 cases). In the 2 patients with filling defect, roentgenographic diagnoses of carcinoma of the pancreas and diverticulum of the duodenum were made. When one realizes that in one case of malignant adenoma of the duodenum the appearance of the tumor by the roentgenological, surgical, and gross pathological examinations suggested carcinoma of the pancreas, the difficulty of exact diagnosis of duodenal malignancy becomes apparent. The very small size of the lesion in another patient with a duodenal malignancy was undoubtedly the reason for the poor visualization in the gastro intestinal series. However, that there was a defect in the second portion of the duodenum is attested by the x ray report of a diverticulum which was not demonstrated at autopsy. Soper, in 1929, emphasized the importance of differentiating diverticulum and carcinoma by the character of the x ray defect and the presence of occult blood in the stool.

In 3 of the 12 patients the x ray studies proved negative. In these patients there was no special barium series of the small intestine, and it is apparent from the surgical and pathological findings that if such studies had been carried out the roentgenological diagnosis would probably have proved positive. In one patient the initial gastro intestinal series showed a questionable dilatation of loops of the small intestine and 2 re-examinations showed negative series. It is apparent that the 4 patients admitted to the hospital with

acute intestinal obstruction received no primary barium studies and are included among the 10 in which such studies were not done.

In this series we were not able to make any observation on the incidence of achlorhydria associated with small intestinal malignancy. In 2 of the patients a gastric analysis was done and in both free acid was present.

In 13 of the 22 patients radical surgery for the resection of the tumor was performed and the intestine re-established either by a side to side, an end to end, or side to end anastomosis. Palliative surgery was done in 6 patients. In 2 of the duodenal cases, a cholecystojejunostomy and choledochostomy were performed for relief of biliary obstruction, and no attempt was made to resect the malignancies. The experience of the Mayo Clinic (5) and others is that lesions of the duodenum are very difficult technically to resect and that usually when they become manifest they are so far advanced that ablation is impossible. In 3 patients short circuiting enterostomies were performed because of extensive local involvement or distant metastases. In another patient the tumor was surrounded by a large abscessed cavity which precluded surgical resection. In 3 patients no surgery was performed.

In an analysis of the end results as seen in the 22 cases of small intestinal malignancy, one finds that 13 patients received radical resection, an operability rate of 59.1 per cent. There were 4 deaths in 13 resections or an operative mortality for resections of 30.8 per cent. Of the resected patients 1 each died of generalized peritonitis, uremia, intestinal obstruction due to intussusception, and in 1 case no cause of death was found at autopsy. Among the group of 9 survivors there were 5 patients who died from 5 months up to 8 years later. There were 4 cases in which death could be attributed directly to recurrence and the longest survival was 2 years. The fifth patient lived 8 years and at postmortem examination the cause of death was proved acute intestinal obstruction with no evidence of recurrence. In addition there were 6 patients receiving palliative surgery, 5 of whom died during the hospital stay due to intestinal obstruction or generalized peritonitis. One

of the 6 patients receiving palliative surgery, was discharged from the hospital improved but because of the inoperability of the cancer is considered dead. Of the total 19 operative cases there were 9 deaths in the hospital, or a total mortality for all surgery of 47.4 per cent.

Thus of the total there are 18 known dead and 3 known and 1 possible living. Among the known living there is one 11 years with no recurrence, one 3 years with no recurrence and one 3 months. A fourth possible survival was living and well 1 year after operation but has been lost to follow up since 1935.

In the final evaluation, a careful history and physical examination may give some clue, presence of occult blood in the stool is important supporting evidence; however, the main proof for the diagnosis rests with the surgeon or roentgenologist. Lacking such signs of small intestinal obstruction or filling defect the roentgenologist is unable to establish the diagnosis. Therefore, the clinical diagnosis has heretofore been made most often at the time of exploratory laparotomy. Many of the small intestinal malignancies especially those of the jejunum and ileum are amenable to surgical resection. Craig commenting on the end results seen at the Mayo Clinic, states that the operative prognosis and longevity are most favorable with lesions of the jejunum. It is therefore to be hoped that both roentgenologist and surgeon will be encouraged to look for these tumors so that a material increase will be made in the proportion of cases in which diagnosis is made or the lesion is suspected before operation and in which operation is performed.

SUMMARY

1 This report contains an analysis of 22 cases of small intestinal malignancy, of which there were 3 duodenal, 12 jejunal and 7 ileal malignancies. Of the total there were 16 carcinomas and 6 sarcomas.

2 An analysis of 134 cases of malignancies of the small intestine, including the author's series, shows malignant tumors of the duodenum and ileum to occur slightly more frequently than malignant tumors of the jejunum.

3 Of the malignancies of the small intestine carcinoma occurs most frequently in

the duodenum and jejunum, and sarcoma in the ileum.

4 The clinical picture of small intestinal carcinoma is variable. Biliary obstruction is most often seen with malignancies about the papilla of Vater and intestinal obstruction with malignancies of the lower duodenum, jejunum, and ileum. Gross bleeding or occult blood in the stools is a frequent finding in malignancy of the small intestine.

5 Any patient presenting signs of intestinal obstruction, change of bowel habit or melena, in whom studies have eliminated any pathology in the esophagus, stomach, colon, or rectum, should have very careful studies to eliminate the presence of malignancy of the small intestine.

6 Roentgenological study with a special barium series of the small intestine is generally recognized as the best positive means of diagnosis but, *per se*, is not infallible.

7 In this series of 22 cases there were 4 operative deaths of the total 13 radical resections, or an operative mortality of 30.8 per cent. Of the total of 19 patients treated by surgery there were 9 deaths or an operative mortality for all surgery of 47.4 per cent.

8 Of the 22 patients, 18 are known dead. Of the survivals 3 patients are living and well with no recurrence for periods of 11 years, 3 years, and less than 1 year. A fourth possible survival was living with no recurrence for 1 year and has been lost to follow up.

9 The surgeon and roentgenologist are encouraged to look for malignancies of the small intestine so that the proportion of cases diagnosed early and cured may be increased.

REFERENCES

- 1 BLAND SUTTON SIR J. B. On cancer of the duodenum and small intestine. *Lancet* 1914 2 931.
- 2 BRILL. Primary carcinoma of the duodenum. *Am J M Sc* 1904 128 824.
- 3 CATTELL R. B. and WOODBRIDGE P. D. Leiomyo sarcoma of the jejunum postoperative renal suppression treated by paravertebral nerve block. *Surg Clin N America* 1931 11 363.
- 4 CLARK E. D. Carcinoma of small intestine report of a case of carcinoma of the ileum. *Surg Gynec & Obst* 1926 43 757.
- 5 CRAIG W. MCK. Lymph glands in carcinoma of the small intestine. *Surg Gynec & Obst* 1924 38 479.
- 6 DEAVEY J. B. and RAVDIN I. S. Cancer of the duodenum. *Am J M Sc* 1920 159 469-477.

- 7 DAVIS J W and MORSE G W Primary adenocarcinoma of the duodenum Report of 12 proved cases Summary of the literature New England J Med 1928 198 383-401
- 8 LEER S A Primary malignant disease of duodenum Arch Surg 1933 27 1087-1103
- 9 TWINE JAMES Neoplastic Diseases a Treatise on Tumors 3d ed p 704 Philadelphia W B Saunders & Co 1928
- 10 JOHNSON R Carcinoma of the jejunum and ileum Brit J Surg 1922 9 422
- 11 JUDD I S Carcinoma of the small intestine Lancet 1919 39 159
- 12 KAUFMAN EDWARD Pathology Vol 1 p 815 Philadelphia P Blakiston's Son & Co 1929
- 13 KIEFER EVERETT D Tumors of the small intestine New England J Med 1933 208 1042-1048
- 14 MILLS R W X-ray evidences of abdominal small intestinal stasis Am J Roentgenol 1922 9 190-225
- 15 MUELLER ERITZ Inaugural dissertation, Basel 1905 (Same reference as in 1,)
- 16 NOTHNAGEL Die Krankheit des Darms Vienna 1898 Abstracted by Clark Carcinoma of small intestine Surg Gynec & Obst 1926 43 757
- 17 RAYFORD J S Tumors of small intestine Radiology 1931 16 253-270
- 18 SCHOFFELD J J Carcinoma of the duodenum Brit J Surg 1930 18 84-90
- 19 SOEFER H W Roentgen ray diagnosis of lesions of small intestine Am J Roentgenol 1929 22 107
- 20 STAFMUELLER MARTIN and REHNEL PAUL Die Neubildungen des Darmes Neue Deutsche Chirurg 1924 (Reference by Rayford)

OXYGEN THERAPY IN REACTIONS FOLLOWING BARBITURATE ANESTHESIA AND CISTERNAL INTERVENTION

J G SCHNEDORF Ph D, M D Detroit Michigan

CEREBROSPINAL intervention is followed by a number of reactions which are of prime importance to the neurosurgeon and internist. These reactions were first brought to our attention during an investigation of Pieron's hypno toxin theory of sleep (6). Elevation of intracisternal pressure and body temperature followed the slow aseptic cisternal withdrawal and replacement of cerebrospinal fluid in normal dogs. Reactions of a similar magnitude occurred in unanesthetized dogs and in dogs anesthetized with pentobarbital.

The literature contains a few observations of the intracranial pressure reactions produced by barbiturate anesthesia and by lumbar and cisternal punctures, but no extensive investigation of these reactions can be found. Bullock, Gregerson, and Kinney report elevations in intracisternal pressure of 40 millimeters cerebrospinal fluid over a 12 hour period in dogs under amylal anesthesia. Elevations in cerebrospinal fluid pressure following lumbar puncture and withdrawal of fluid in man has been observed (11, 14, 15). Cases

of aseptic meningitis in humans with elevations of body temperature and cerebrospinal fluid cell counts following lumbar and suboccipital puncture have been reported by a number of observers (5, 9, 16, 17). Kasahara, Takasaki, and Yamada have shown in an experimental study upon rabbits and dogs that cisternal replacement of 0.5 to 1 cubic centimeter of cerebrospinal fluid with air is followed by a cellular pleocytosis up to 2,013 cells per cubic centimeter of cerebrospinal fluid. There also occurred an increase in spinal fluid protein. The pleocytosis reached a maximum 3 to 6 hours after the procedure and the cerebrospinal fluid did not return to normal until after 3 to 7 days. Schwab and von Storch found leucocytic pleocytosis and erythrocytes in the cerebrospinal fluid of humans after more profound cerebrospinal intervention associated with cephalography. Maximum cellular reaction occurred in 6 hours and usually disappeared in 48 hours but occasionally persisted for 6 to 8 days.

This work presents the results of an investigation of the reaction following barbiturate anesthesia and aseptic cisternal intervention

TABLE I—EFFECT OF NASAL OXYGEN UPON REACTIONS TO BARBITURATES AND CISTERNAL INTERVENTION—WITNESS 6 DOGS EACH COLUMN

	A			Cisternal withdrawal placement for cerebrospinal fluid																	
				Pentobarbital									Amytal								
	Pentobarbital			Amytal			Control			Oxygen			Control			Oxygen					
	CSF pres	RT	Resp	CSF pres	RT	Rp	CSF pres	RT	Resp	CSF pres	RT	Rsp	CSF pres	RT	Resp	CSF pres	RT	Resp	CSF pres	RT	Resp
Basal	90	12		90	10.8	17	96	100.1	15	95	12	11	97	1.3	10	96	101.7	8			
h	93	12.2		4	11.8	17	14	100.1	9	1.5	1	0	54	101.0	1	143	1.1	8			
h	93	12.3	2	90	1.9	7	174	100.0	0	141	00.3	10	100	1.8	13	60	100.7	7			
3 h	4			1.5		8	1	1.1	13	146	100.4	10	53	103.7	5	16	00.3	17			
h rs	1	4		14	11.3	13	30	3.0		161	00	5	163	104.3	16	46	90	7			
5 h rs		5		7	02.5	3	1.3	1.6	13	64	100.6	4	8	04.5	9	48	03.5	7			
6 h	5	9		1.5	5	13	0	103.4	4	141	1	6	100	105.0	34	136	08.5	17			
h	1	3		7	5	18	2	3.0	17	134	101.1	16	155	1.5	35	76	05.6	17			
8 h rs		1		6	2.5	9	03	3	7	12		4	6	60	101.5	35	14	00.7	7		

CSF pres.—Cerebrospinal fluid pressure

RT—Rectal temperature at

Resp—Respiration

in the dog and of the role played by anoxemia and of the anxiolytic effects of oxygen therapy upon these reactions

4. THE EFFECT OF BARBITURATE ANESTHESIA UPON INTRACISTERNAL PRESSURE RECTAL TEMPERATURE SPINAL FLUID PROTEIN AND CELLS AND UPON BLOOD ARTERIAL OXYGEN SATURATION

Procedure Continuous intracisternal cerebrospinal fluid pressures were recorded in 6 dogs under sodium pentobarbital and in 6 dogs under sodium amytal anesthesia. Both barbiturates were given intravenously in doses of 30 to 35 milligrams per kilogram of body weight. In order to maintain the anesthesia each dog received an additional intramuscular injection of 1.0 milligrams 3 and 6 hours after the onset of the experiment.

Surgical asepsis was maintained, all apparatus was autoclaved for 30 minutes under 20 pounds pressure. The back of the dog's head and neck was cleanly shaved, 7 per cent iodine and 70 per cent alcohol was applied and the animal was draped with sterile towels.

A twenty gauge needle was then inserted into the cisterna magna and the cerebrospinal fluid was permitted to ascend into the capillary manometer attached by means of a T

tube. This caused a displacement of only about 1 cubic centimeter of cerebrospinal fluid. The cerebrospinal fluid pressure, rectal temperature and respiratory rate were recorded at hourly intervals for 8 hours. Basal conditions of water balance were maintained by depriving the dogs of water for 12 hours before they were used.

In another series of dogs total protein and total cell count determinations were performed upon cerebrospinal fluid withdrawn from the cisterna magna of 6 dogs after 8 hours of pentobarbital anesthesia and amytal anesthesia in 6 additional dogs. Total spinal fluid protein was estimated turbidimetrically after precipitating with sulfosalicylic acid reagent. This method has been used by Denis and Ayer with satisfactory results and has been found to check with the Kjeldahl procedure according to Mattice.

In 3 dogs of each of the latter series blood samples were obtained under oil from the exposed carotid artery of amytal dogs only at $\frac{1}{2}$, 4 and 7 hour intervals after the administration of the anesthetic. The samples were analyzed for oxygen content and oxygen capacity according to the method of Van Slyke.

Results The effects of barbiturate anesthesia are averaged in Table I and graphed in

TABLE II—CEREBROSPINAL FLUID CELLS AND PROTEIN IN THE DOG

Dog	Normal-anesthetized		Pentobarbital						Amytal	
			Alone		Cisternal intervention		Cisternal intervention and nasal oxygen		Alone	
	Cells	Protein	Cells	Protein	Cells	Protein	Cells	Protein	Cells	Protein
1	10	20	10	20	1800	120	850	65	4	10
2	17	25	8	10	660	90	560	60	3	10
3	5	20	3	20	1800	130	131	20	12	15
4	7	20	2	10	1140	140	418	45	6	20
5	5	30	8	10	1104	90	1030	90	5	15
6	3	10	16	15	1260	65	986	60	10	20
Av	7	20	7	14	1193	122	672	53	6	15

Figure 1 Pentobarbital anesthesia in 6 dogs caused an average elevation of cerebrospinal fluid pressure of 23 millimeters over a period of 8 hours. Amytal anesthesia in 6 dogs caused an average elevation of 29 millimeters. There was a slight associated elevation of rectal temperature, namely, 0.9 degree F in those dogs given pentobarbital and 0.7 degree F in dogs given amytal, with no significant alterations of the respiratory rate.

No significant alteration of cerebrospinal fluid cells and protein was observed after 8 hours of pentobarbital and amytal anesthesia (Table II).

Table III shows that barbiturate anesthesia produced a marked depression of arterial blood oxygen saturation from a normal average in 3 dogs of 93.3 per cent to 68.8 per cent with pentobarbital and 83.6 per cent with

amytal $\frac{1}{2}$ hour after its administration. Four hours later the oxygen saturation under pentobarbital rose to 84.6 per cent while under amytal it fell to 79.1 per cent and in the latter case rose to 92.5 per cent after 7 hours.

B REACTIONS TO ASEPTIC CISTERNAL WITHDRAWAL AND REPLACEMENT OF 8 CUBIC CENTIMETERS OF CEREBROSPINAL FLUID IN DOGS UNDER BARBITAL ANESTHESIA

Procedure Procedure A was repeated upon another group of 6 dogs under pentobarbital and 6 dogs under amytal anesthesia. After the initial intracisternal pressure was measured, 8 cubic centimeters of cerebrospinal fluid was slowly aspirated and replaced. This procedure usually took 5 to 6 minutes and resulted in no loss of cerebrospinal fluid.

Protein and cell count determinations were performed upon samples of cerebrospinal fluid obtained 8 hours after slow aseptic cisternal aspiration and replacement of 8 cubic centimeters of cerebrospinal fluid in another group of 6 pentobarbitalized dogs. In 3 of these dogs blood samples for oxygen analysis were obtained $\frac{1}{2}$ hour and 4 hours after the cisternal intervention.

Results Aseptic cisternal withdrawal and replacement of 8 cubic centimeters of cerebrospinal fluid in the anesthetized dog resulted in a progressive increase in intracisternal pressure (Table I). With 6 dogs under pentobarbital the average increase in pressure above normal was 124 millimeters (Fig. 2) and under amytal the pressure of 6 dogs rose 156 millimeters of cerebrospinal fluid above normal (Fig. 3). The peak of elevation of cere

TABLE III—SUMMARY OF BLOOD GAS ANALYSIS—CAROTID ARTERY—AVERAGE 3 DOGS EACH COLUMN

Blood gas analysis	Normal anesthetized	Pentobarbital						Amytal		
		At 0.5 hour		Cisternal intervention		Cisternal intervention and nasal oxygen		Alone Femoral artery		
		0.5 hour	4 hours	0.5 hour	4 hours	0.5 hour	4 hours	0.5 hour	4 hours	7 hours
Oxygen content	16.9	12.4	15.5	13.5	15.8	17.6	17.8	13.3	14.5	17.6
Oxygen capacity	18.7	18.4	18.4	18.0	18.0	18.5	18.5	18.4	18.4	18.4
Oxygen saturation	93.3	68.8	84.6	74.4	87.2	95.7	96.6	83.6	79.1	92.5
Carbon dioxide content	40.6	40.0	42.5	43.7	42.8	47.0	43.4			

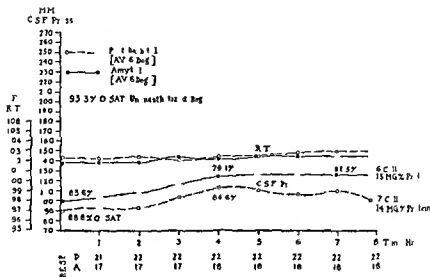


Fig. 1 Reactions to pentobarbital and amytal anesthesia 30 to 35 milligrams per kilogram intravenously

brospinal fluid pressure occurred about 4 hours after the cisternal intervention following which the pressure decreased slowly but was still elevated 62 millimeters with pentobarbital and 92 millimeters with amytal above normal 8 hours after the intervention. There occurred a gradual elevation of rectal temperature above normal 3.9 degrees F with pentobarbital and 4.2 degrees F with amytal and the respiratory rates were increased 9 and 19 respirations per minute respectively.

Eight hours after the procedure there was a definite increase in the number of cells or an average of 1204 and an average total protein of 122 milligrams per cent in the cerebrospinal fluid (Table II). Arterial oxygen saturation was reduced to 74.4 per cent after $\frac{1}{2}$ hour and 88.1 per cent in 4 hours. Dogs that were permitted to recover were normal the morning after they were used and showed no subsequent deleterious effects.

C EFFECT OF NASAL OXYGEN THERAPY UPON THE REACTIONS FOLLOWING ASEPTIC CISTERNAL WITHDRAWAL AND REPLACEMENT OF 8 CUBIC CENTIMETERS OF CEREBROSPINAL FLUID

Procedure Procedure B was repeated upon another series of 6 dogs under pentobarbital anesthesia. In addition each dog received

99.5 per cent oxygen by means of a nasal catheter at the rate of 10 liters per minute. This rate of flow produces an alveolar oxygen content of 50 to 55 per cent according to Barker, Parker, and Wassell.

Results The results are averaged in Table I and graphed in Figures 2 and 3. The average elevation of cerebrospinal fluid pressure following cisternal intervention was only moderate in the dogs which received oxygen. The elevation above normal was 60 millimeters under pentobarbital and 54 millimeters under amytal anesthesia. Rectal temperatures fell and there was no significant alteration in respiratory rates. Analysis of the cerebrospinal fluid showed an average cell count of 672 and only 53 milligrams per cent of protein. Arterial blood oxygen saturation was elevated 93.7 per cent above normal in $\frac{1}{2}$ hour and 96.6 per cent in 4 hours.

D SPINAL FLUID CULTURES AFTER CISTERNAL WITHDRAWAL AND REPLACEMENT OF CEREBROSPINAL FLUID

Procedure Two cubic centimeters of cerebrospinal fluid were withdrawn from each of 4 pentobarbitalized dogs immediately after cisternal intervention and were cultured upon brain broth and subsequently upon blood agar plates.

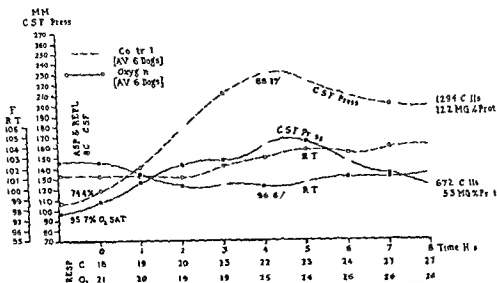


Fig. 2. Effect of nasal oxygen upon reactions to cisternal intervention in dogs under pentobarbital anesthesia.

Results All 4 of the broth cultures were clear after 48 hours' incubation at 38 degrees. No colonies could be grown upon blood agar plates inoculated with the broth cultures. Failure to demonstrate organisms in the cerebrospinal fluid of the dogs following cisternal withdrawal and replacement of cerebrospinal fluid demonstrates that the reactions observed are aseptic. This is further borne out by the failure of any of the dogs permitted to recover to display any signs of meningitis or encephalitis.

OBSERVATIONS

Pentobarbital and amytal anesthesia produce a significant depression of oxygen saturation of arterial blood. Pentobarbital caused 68.8 per cent or the greatest depression of blood oxygen saturation $\frac{1}{2}$ hour after its administration. Considerable recovery, or 84.6 per cent, occurred in 4 hours but this was still definitely below normal or 93.3 per cent. Under amytal anesthesia the depression of blood oxygen saturation at the $\frac{1}{2}$ hour interval was 84.6 per cent but at 4 hours it had dropped to 79.1 per cent. Amytal, therefore, did not produce such a severe anoxemia but it was more persistent than that produced with pentobarbital and was about normal or 92.5 per cent 7 hours after its administration. McClure, Hartman, Schnedorf, and Schelling have obtained similar depression of arterial

oxygen saturation in dogs with dial, evipal, and amytal.

In addition to this depression of blood oxygen saturation there is evidence in the literature which indicates that barbiturates cause a direct inhibition of the respiration of brain tissue. Jowett reports depressions of 6 to 32 per cent in the oxidation of glucose, lactate, and pyruvic acid substrates by brain tissue slices when luminal or evipal are added. He employed the manometric method of Warburg. Employing the same technique, Hundhausen has reported a decrease in oxygen consumption by surviving cortical and brain stem tissues of rabbits anesthetized with luminal and evipal.

The anoxemia *per se* observed in our dogs did not produce a significant alteration in cerebrospinal fluid pressure or spinal fluid protein or cells. Over an 8 hour period the average pressure rose 23 millimeters under pentobarbital and 29 millimeters under amytal. The more prolonged anoxemia produced by amytal was associated with the slightly higher elevation of cerebrospinal fluid pressure. No significant alteration of rectal temperature and respiration occurred. The effect of repeated daily administrations of these barbiturates was not investigated.

Even mild cerebrospinal intervention as the slow aseptic withdrawal and replacement of 8 cubic centimeters of cerebrospinal fluid,

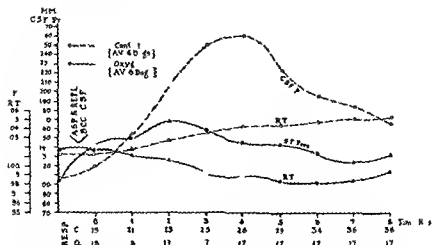


Fig. 3 Effect of nasal oxygen upon reactions to external intervention in dogs under amylal anesthesia

which is from 35 to 50 per cent of the total volume is followed by profound reactions. Arterial blood oxygen saturation was 74.4 per cent at the $\frac{1}{2}$ hour period and 88.1 per cent at the 4 hour period. These values are relatively higher than those with anesthesia alone which are 68.6 per cent after $\frac{1}{2}$ hour and 83.6 per cent after 4 hours, because of the hyperpnea which occurred together with an elevation of temperature in these dogs after external intervention. The trauma of the slow aspiration and replacement of from 35 to 50 per cent of the total volume of cerebrospinal fluid superimposed upon the capillaries and cells already subjected to anoxemia resulted in their increased permeability so that protein, erythrocytes and leucocytes appeared in the cerebrospinal fluid in increased amounts and there occurred a marked increase of 124 to 156 millimeters above normal in cerebrospinal fluid pressure. Landis reported that 4 minutes of anoxemia increased the capillary permeability in a frog's mesentery so that fluids filter through its walls at approximately 4 times the normal rate.

Administration of nasal oxygen restored the arterial oxygen saturation to values above normal, namely 95.7 per cent in $\frac{1}{2}$ hour and 96.6 per cent in 4 hours. The "tonic effect" of oxygen upon the capillaries in decreasing permeability is shown by the smaller number

of cells and decreased quantity of protein occurring in the cerebrospinal fluid of the dogs which received oxygen. In addition the cerebrospinal pressures did not rise so high above normal in these dogs but only to 69.63 millimeters and returned to a lower level sooner than in the dogs which did not receive oxygen. The rectal temperature remained low partially because the intracranial pressure was not greatly elevated and also because of the cooling action of the oxygen in the nasopharynx of the dogs.

This evidence would seem to indicate that barbiturates produce an anoxemia through alterations in the depth of respiration. The work of Jowett and of Hundhausen shows that barbiturates also cause a depression of oxygen utilization by the brain tissue through a direct histotoxic action. The anoxemia and histotoxic action alone produce only slight and insignificant elevations in cerebrospinal fluid pressure and no alteration of cerebrospinal fluid protein and cell content. The superposition of mild trauma such as occurs with slow aseptic withdrawal and replacement of from 35 to 50 per cent of the total volume of cerebrospinal fluid results in shock and edema of the brain. The increased permeability of the capillaries results in increased exudation of protein and cells causing significant elevations in cerebrospinal fluid pressure. The elevation in temperature is appar-

ently due to the direct effect of the increased intracranial pressure upon the temperature regulating center in the brain stem. Oxygen therapy restores the oxygen content of the blood even above normal, restores capillary tone so that less protein and fewer cells pass into the cerebrospinal fluid and the intracranial pressure becomes elevated to only a moderate degree.

CONCLUSIONS

1 Pentobarbital and amytal anesthesia produce a decrease in the oxygen saturation of arterial blood which persists for more than 4 hours.

2 The barbiturates produce only slight elevations of cerebrospinal fluid pressure, or 23 to 29 millimeters above normal and no significant alterations in spinal fluid protein or cells.

3 Aseptic cisternal withdrawal and replacement of 8 cubic centimeters of cerebrospinal fluid causes an increase of 122 milligrams per cent in cerebrospinal protein, an average cell increase of 1,294, a marked elevation of cerebrospinal fluid pressure, 124 to 156 millimeters, an increase in body temperature of 3.9 to 4.2 degrees F and in respiration of 9 to 19 above normal.

4 Nasal oxygen therapy restored arterial oxygen saturation. The amount of protein was reduced to 53 milligrams per cent and the number of cells in the cerebrospinal fluid was also reduced to 672. Elevations in cerebro-

spinal fluid pressure were moderate, only 69 to 63 millimeters, and returned to lower levels sooner than in dogs which did not receive oxygen. Elevations of temperature and respiration did not occur.

5 Oxygen therapy is indicated for the amelioration of symptoms and reactions incident to barbiturate poisoning and cerebrospinal intervention.

Sincerest appreciation is expressed to Dr. Frank W. Hartman and Dr. Roy D. McClure for their co-operation which has made this work possible.

BIBLIOGRAPHY

- 1 BARKER, PARKER and WASSILL. *J Am M Ass* 1934 103 244
- 2 BULLOCK, GREGERSON and KINNEY. *Am J Physiol* 1935 112 82
- 3 DENIS and AYER. *Arch Int Med* 1920 26 436
- 4 HUNDHAUSEN. *Ztschr f d ges exper Med* 1938, 102 477
- 5 HUNTAL. *J Am M Ass* 1933 100 1499
- 6 IVY and SCHNEDORF. *Am J Physiol* 1937 119 34
- 7 JOWETT. *J Physiol* 1938 92 322
- 8 KASAHARA, TAKAIKAI and TAMADA. *Ztschr f d ges exper Med* 1932 80 347
- 9 KUHY. *Deutsche Ztschr f Nervenb* 1936 139 300
- 10 LANDIS. *Am J Physiol* 1927 82 59
- 11 MASSERMAN. *Arch Neurol & Psychiat* 1934 32 523
- 12 MATTICE. *Chemical Procedures for Clinical Laboratory* P 387 Philadelphia Lea and Febiger 1936
- 13 McCLURE, HARTMAN, SCHNEDORF and SCHELLING. *Ann Surg* in press
- 14 OBREGIA, DIMOLESCU and PARVANESCU. *Ztschr f d ges Neurol u Psychiat* 1934 150 748
- 15 PACIFICCO. *Riv di patol nerv* 1934 43 1215
- 16 REMSEN. *J Med* 1936 17 115
- 17 REYNOLDS and WILSON. *J Am M Ass* 1934 10 1460
- 18 SCHWAB and VON STORCH. *New England J Med* 1937, 217 21
- 19 VAN SLYKE and NEILL. *J Biol Chem* 1924 61 523

THE MANAGEMENT OF HEMATOGENOUS PELVIC OSTEOMYELITIS

J KULOWSKI MD FACS St Joseph Missouri

ADVANCES in diagnosis and clinical life history of hematogenous osteomyelitis of the pelvic girdle emphasize the need for remediable interpretation of operative results and revision of therapeutic indications. Early recognition of the disease results in a conservative attitude toward initial surgical treatment as a paradox to the urgency of immediate operation and necessity for later radical methods. A review of the literature and an analysis of 109¹ cases suggest that therapeutic confusion has arisen from failure to appraise the local lesion in its relationship to the associated systemic infection in the early stages of the disease. Consequently indiscriminate initial operations and subsequent temerity have reflected unfairly upon and discredited sound surgical procedures in reference to the mortality and morbidity of the disease.

Unbiased observation of the local lesion at any stage of its development will determine the treatment on its own merits. Therapeutic methods appropriate for the subacute and chronic phases of the disease are ill advised during its initial manifestations. As a matter of fact the early clinical situation has been distorted by the prevalence of chronic lesions the pitiful condition of which has prompted the conception of eradication measures at the onset of symptoms. This ideal is moderated with the realization that such patients have survived the original bacterial systemic onslaught in spite of surgical delay. Now the initial phases of the problem emerge in their proper ratio to the forefront of clinical attraction.

Vague retrospective therapeutic impressions based upon distal extremes of the disease yield to clarification from its proximally superimposed systemic and local levels. The

latter furnishes the key to the therapeutic problem as a whole because of the initial unpredictable pathogenetic factors which govern the subsequent course of the disease. The obstacles to an immediate interpretation of the local therapeutic requirements demand a progressive objective evaluation of the entire clinical situation from its inception. This paper is based on the premise that the tendency toward natural compensation as reflected in the pathogenesis and pathology of the disease indicates a therapeutic pattern in harmony with its clinical life history. It is my purpose to refer to those factors which determine a distinctive clinical grouping of cases and to discuss their diagnosis and therapeutic management.

PATHOGENESIS

Since the entire life history of the disease has not yet been evolved its diagrammatic representation is arbitrarily divided into preclinical and clinical phases (Chart 1). The former includes assumed but convincing trigger causal and predisposing factors namely, port of bacterial entry, trauma and lowered immunological resistance. Topical and general infections and direct and indirect injuries often precede the onset of pelvic osteomyelitic symptoms. The primary infectious focus as an active latent or potential source of danger requires elucidation. Rarely a hematogenous osteomyelitis occurs at the site of a simple fracture of the pelvis. The reactivating influence of trauma in flares is recognized.

Although the clinical division is neatly separated into systemic and local elements the dynamic reciprocal interrelations of the various stages is fundamental. The most important item in the early stages as a rule is the general infection. It comprises the stages of bacteremia and bacterial bony seeding. Contrary to casual opinion hematogenous medullary may be substituted by cortical

¹The vast majority are from the University Hospital at Iowa City; the remainder from the St. Joseph Missouri Methodist Hospitals St. Joseph, Mo.

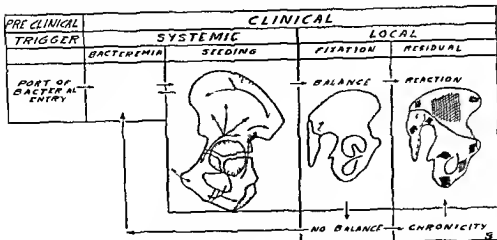


Chart 1 Schema of pathogenetic development and course of hematogenous pelvic osteomyelitis

articular, juxta epiphyseal or subperiosteal "seeding," depending upon specific vascular sensitization.

The local level of the disease is characterized by bony "fixation," development of the local lesion, and its residual scar "Fixation" is initiated by a thrombo embolic process which may continue independently by retrograde progression (Fig 1). Wilensky's studies hardly admit of any other explanation. Ollier's teachings of the importance of the juxta epiphyseal zone in the development of hematogenous osteomyelitis of the long bones is basic. Gouliad (quoted by Badgley) carried this analogy to the pelvic situation. He conceived the diphasic focal syndrome corresponding to the two periods of its bony development. Skeletal localizations usually occur proximal to the acetabulum before puberty, and henceforth in the vicinity of the secondary marginal epiphyses (Fig 2).

The least understood of all pelvic foci are derived from the sacro iliac synchondrosis. Accurate differentiation between bony and articular lesions is imperative. This is not difficult in cases carefully observed from the onset of symptoms. The possibilities in this respect are apparently determined by the same factors which govern hematogenous pyogenic bone and joint infections in general. Lesions affecting this region are classified as isolated suppurative arthritis of the sacro iliac joint, juxta articular osteomyelitis of the sacrum or ilium, and/or a pan osteomyelitis (sacro ileitis).

Suppurative evolution of the local lesion

affects an equilibrium between the systemic and local infection in the usual case. The end result is then determined by the local lesion. When such balance is delayed or does not occur, the disease may continue indefinitely, or the end result is fatal due to uncontrollable complications. The mortality from an uncomplicated local lesion is nil. Not infrequently the lesion evolves without gross evidence of suppuration.

The residual stage of the lesion results from the reaction between the inflammatory process and the collateral ischemia incident to the underlying thrombo embolic process. Local balance is usually expressed by sequestrum formation which in turn may disturb its stability.

PATHOLOGY

Para osseous abscesses dominate the gross pathological situation. They often mask the bony lesion and are formidable sources of local infection and toxic absorption. They frequently spread out of fascial bounds by active lateral expansive dissection. The rapidity and direction of purulent progression either horizontally or vertically depends upon its origin relative to the bony surfaces.

Suppuration arising from the posterior segment of the bony pelvis usually collects in the iliopectineal or subiliac space. Not infrequently they emerge below the greater sacrospinous notch or above the brim of the pelvis in the retroperitoneal tissues. Pus originating from the sacro iliac joint perforates the antero-inferior weakest portion of its capsule into the iliopectineal or subiliac space. That from the

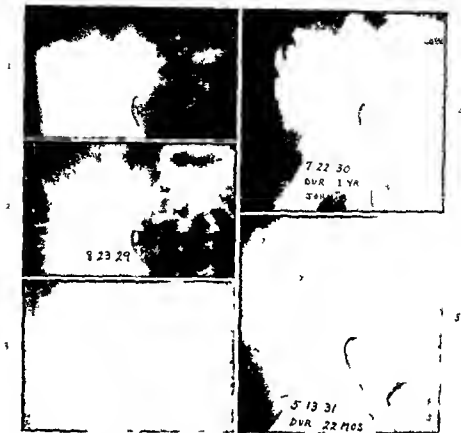


Fig. 1. Roentgenogram of an iliac lesion illustrating characteristic extension by retrograde progression and complete evolution of the lesion. Duration: 1. 22 days; 2. 23 days; 3. 29 days after simple incision and drainage; 4. 30 days; 5. 31 months.

ischium fills the subgluteal space and occasionally the ischioanal fossa. It may also burrow along the ascending ramus of the ischium to the groin, scrotum or vulva. Pubic foci involve the space of Retzius or Scarpa's triangle and the adductor region. Foci originating above the iliopectineal line form characteristic abscesses in the internal iliac fossa.

Due to the intimate relation between the pelvic and femoral fascial spaces (Prentiss-Milgram) the anterior and posterior fascial compartments of the thigh may be invaded. The most bizarre routes of gravitational and even retrograde purulent infiltration is frequently observed. Huge retroperitoneal collections of pus may result from any pelvic focus. Pelvic viscera are rarely perforated. The virulence of deeply situated abscesses occasionally becomes spontaneously exhausted

or remains as an asymptomatic ("silent") source of remote metastatic infections.

Paraosseous edema and juxta epiphyseal hyperemia is the earliest surgical pathological change noted. In the second or third week an iliac lesion is distinguished as a pale moth-eaten island with marginal congestion and early patchy involucrum which is already partially imbedded in granulation tissue. Finally gross exfoliation and sequestration is not as uncommon as the literature would indicate (Fig. 3). Those from the iliac wing lead to variegated but characteristic cystern formations in the internal iliac fossa. Extensive ischial sequestra often lie in a soggy bed of infective granulation tissue from which they can be lifted out *en masse*. Sequestra in relation to the sacroiliac synchondrosis are usually situated antero-inferiorly as sharply



Fig 2 Roentgenograms illustrating characteristic developmental localization of the disease 1 Ischiopubic male aged 7 years, 2 weeks duration 2 supracotyloid female aged 11 years 33 days duration 3 anterosuperior border of the ilium female aged 13 years 8 weeks duration 4 subcotyloid ischium female aged 6 years 36 days duration

outlined triangular portions or slivers of the ilium or sacrum

The characteristic histological sequence is disclosed as an acute cellular, subacute dry fibrous reaction and final simultaneous resorption of dead and reorganization of new bone. It is evident that passive reaction at a distance is clinically often interpreted as an active destructive participation. The epiphyseal cartilage does not show abnormal changes in the initial stages. The most intensive interstitial marrow invasion of acute inflammatory products and scattered necrosis of bone cells occurs at the initial site of origin. There is

an almost immediate response by granulations which are intricately pervaded and supported by a network of very immature osseous tissue. Henceforth lacunar resorption and bony reposition go hand in hand.

Chronic lesions reveal almost a complete absence of normal hematopoietic marrow and are predominated by irregular osteosclerotic inflammatory reaction and reorganization. The marrow is displaced by hyperemic fibrous tissue which may still show evidences of slight cellular infiltration. Marked osteoclastic resorption continues about sequestral craters, and here the deeper layers of the granulation

TABLE I—AUTHOR'S SCHEMA OF THERAPEUTIC INDICATIONS ON BASIS OF CLINICAL DEVELOPMENT

D n	Precl cl	Cln l			
Ph es	T gr	S y t m u c L e l		L o c l L e v e l	
S i g	P m r y f e c t	R c t m	S e e d g	F i x a t	R e s J u l
C l i j d e l p m t	V n a b l e	T t m	A b s t r e p e s p p a s e	N a s p p t e S p p a l y	S e q e s t r u m
S m p t m s	V n b l e	A t i n f e c t d e a	S h y p e r o s t e o m y l i t e n e	O b e r t C l c l d g n	N a y
T r e t m t	P r i m a r y c t l			S e c d a r y c n t l	
	P e t p r o t h y l	H i p t a b i l i	S e d t o M e c h u c l	C e r v t p e t i n	R d c l p e t i n
	S y m p t m a l I m m u n i t y p	S y m p t m a l t h a p c h m o n t n f u p r		P n t n f e c d a r y n f e c t n a d d f m t y (O e r m t h o d)	

tissue form scar. On the surface there may still remain an exhausted (necrotic) exudate in which are numerous necrotic bone spicules in an advanced stage of organization and resorption. Lesions of the sacro iliac synchondrosis show variable changes such as loss of the joint cartilage, calcification or obliteration of the joint and reactive sclerosis of the opposing bones.

Extension by bony contiguity belongs to the later neglected stages. The peculiar bony configuration of the innominate bone facilitates mechanical extension along architectural trabecular systems. This not infrequently leads to hemipelvic and even lumbosacral involvement. Hip joint complications are common and may be predicted from supracotyloid and infracotyloid juxta articular foci. Contiguous spread of lesions affecting the sacro iliac syn-

chondrosis often obscures its exact focal point of origin. Medial sacral invasion may determine a fatal outcome from meningeal involvement (Fig. 4). On the other hand the denser contiguous portion of the ilium is often an effective barrier to lateral extension of the lesion.

The residual stage of the disease is conspicuous by uncontrolled new bone formation which has its redeeming as well as unpleasant features. The tendency toward regeneration—even after total resection—is almost certain in the young. The amount and irregularity of new bone formation may add to technical operative difficulties and obscures roentgenographic interpretation of the primary lesion. This power of the periosteum, however, may be weakened or inhibited entirely in older persons or because of constitutional inferiority, initial thrombotic death of the periosteum from intense parosteal infection, therapeutic neglect and indiscriminate operative interference.

BACTERIOLOGY

The staphylococcus is recovered from the blood stream and local lesion in the great majority of instances under proper conditions. Sterile cultures always indicate a careful differential laboratory and clinical study. The mixed bacterial forms most commonly a combination of staphylococcus and streptococcus, are usually due to secondary infection. The bacteriological significance of pyogenic hematogenous osteomyelitis is becoming more clearly defined. Many organisms exert a limited influence and are characterized by a more or less benign inflammatory reaction and clin-



Fig. 3. Photograph of operatively resected achial lesion of 6 years duration. Microscopically the entire achium was necrotic. The immediate paraosseous tissues formed a cloaca for ramifying sinuses emanating from intrapelvic and extrapelvic depths.



Fig 4 Photograph of postmortem pelvic specimen of an extensive residual sacroileitis in a male aged 17 years 18 months after onset Left to right lateral articular view of diffusely involved sacrum no doubt the original site of the disease Sacral canal and meninges were terminally affected Internal surface of ilium showing ineffective but marked reactive juxta articular sclerosing response to invasion of the iliac wing and acetabulum

ical course Streptococcal and some of the more unusual forms of bacteria often belong to the latter group The necrotizing action of staphylococcal exotoxin is claiming renewed interest in regard to immunotherapeutic possibilities

DIAGNOSIS AND CLINICAL COURSE

The symptomatic expression of the disease permits clinical grouping of cases on the basis of the pathogenetic development (Table I) But it is important to remember that the systemic manifestations may merge, appear simultaneously with, or be preceded by, the local subjective and objective symptoms The systemic subgroups, abortive and presuppurative, are introduced to designate subjective symptomatic peripheral invasion of the skeletal tissue Both classifications are symptomatically identical but should not be employed synonymously If the course of the disease terminates spontaneously with no residual

subjective or objective local signs and symptoms, it is called abortive When the term "presuppurative" is used one looks tentatively forward from the initial stages of the disease, since suppuration may yet occur

The local fixative subgroups, non suppurative and suppurative, indicate conclusive objective peripheral skeletal invasion and participation These, too, are symptomatically almost identical initially, but develop differently By non suppurative usage one looks backward on the acute stage from the stage of convalescence The term should be reserved until all danger of local suppuration has passed, although residual bone changes may have progressed even to the stage of sequestration Spontaneous regression even under such conditions is yet possible The residual stages of the local lesion or scar are ushered in by gross bone changes, demonstrable on x ray examination and usually characterized by demarcation of affected bone



Fig. 5. Roentgenogram of sacro-iliac uppurative arthritis 1 year after onset and 1 week after an uneventful obstetrical delivery of a normal infant. Unhooking at the symphyseal joint is associated with sacro-iliac joint ankylosis.

Since the local lesion is of hematogenous origin the systemic infection demands primary consideration and one should be ever on the alert for localizing signs and symptoms of suppuration. The initial clinical problem simply stated is therefore presumptive diagnosis and surgical therapeutic restraint. The uncertainty of an immediate conclusive diagnosis, the severity of the general infection and the unpredictable course of the disease precludes any other line of action.

A reasonably early diagnosis depends upon an awareness of the relative frequency of the disease as it affects all portions of the pelvic girdle. The various lesions in this series were distributed as follows: ilium 39, ischium 26, sacro-iliac synchondrosis 22, sacro-iliac joint 10, pubis 5, sacrum 3, and coccyx 1. Since there are no basic differences between these foci in reference to differential diagnosis, mortality, morbidity, and therapeutic indications, the clinical situation is best considered as a whole.

In the acute stages of the disease the initial lesion is characteristically subordinated to or masked by the systemic reaction and simulative signs and symptoms referable to visceral retroperitoneal and hip joint irritation. The profound toxemia, positive blood culture, absence of position of relief and responses to



Fig. 6. Roentgenogram showing residual sacro-iliitis with typical lateral pelvic shift.

spontaneous and provoked pain should suggest the true nature of the condition. Initial peripheral objective signs and symptoms, such as edema, superficial venous engorgement and generalized tenderness, indicate a definite shift to the local or diagnostic level of the disease. Major responsibility now centers about evaluation of the concomitant triad of symptoms referable to the hip joint, such as pain, tenderness and asymmetrical attitude.

The hip joint may be either primarily or secondarily affected from a rapidly extending juxta-articular lesion. Marked symptoms referable to the hip joint associated with obturator nerve radiation are almost pathognomonic of its relative or absolute participation, although painful obturator or sciatic nerve reference is not infrequently observed in uncomplicated instances of pelvic osteomyelitis. When digital tenderness accompanies painful radiation, the possibility of an associated femoral lesion should be considered.

Primary hip disease is physically expressed by an absolute or concentric restriction of function. The resultant spontaneous deformation of the hip joint is characterized by flexion, abduction and external rotation. However, some degree of motion may be elicited early before the joint cartilage is involved and later because of ligamentous and capsular relaxation incident to hydrostatic distention.

As a corollary to this, the sympathetic asymmetrical attitude of the hip due to juxta

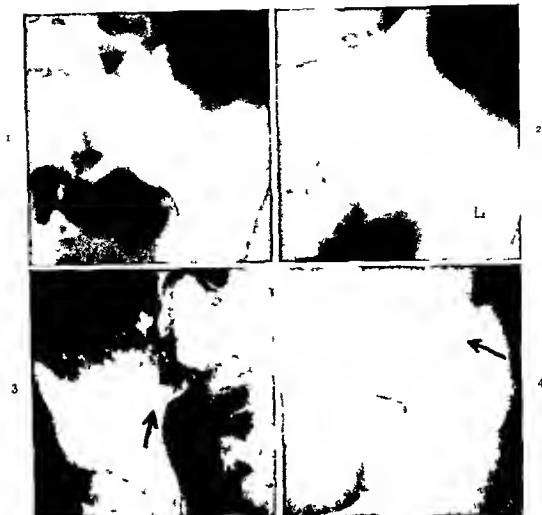


Fig 7 Roentgenograms of lesions affecting the sacro iliac synchondrosis illustrating early and later differential characteristics between bone and joint participation 1 Sacro ileitis of 3 weeks duration characterized by osteoporosis and accentuation of the iliac juxta articular vascular channels 2 sacro iliac joint suppuration of similar duration characterized by blurring of the articular margins beginning reactive para articular increased calcification and loss of the vascular striae No disturbances of pelvic equilibrium were noted in either case at this stage 3 sacro ileitis of 6 weeks duration showing destruction sequestration and pelvic shift in contrast to 4 old residual sacro-iliac suppurative arthritis of 11 years duration showing resultant para articular sclerosis fusion of the joint, and absence of pelvic asymmetry

articular or para articular foci, is activated by relative protective muscle spasm. Extra-articular conditions will allow a considerable range of motion in planes unaffected by pelvi femoral or lumbopelvic muscles arising from or inserting at sites of involvement. Later this attitude becomes more pronounced as a result of purulent hydrostatic infiltration. Still later deformity becomes more or less fixed due to bony pelvic distortion or destruction, or actual invasion of the hip joint.

When the focus is in the ilium, the hip is characteristically in flexion and abduction. Flexion predominates when the lesion arises

from the sacro iliac region. Ischial foci result in external rotation of the femur and abduction. Pubic lesions lead to flexion, adduction, and internal rotation.

The general reaction, pain, tenderness, eccentric limitations of hip joint motion, and *negative hip aspiration* are strongly suggestive of an acute osteomyelitis of the pelvis. Actual infiltration, fluctuation, and circumscribed tenderness, all of which are confirmed by vaginal or rectal examination, and focal aspiration, clinch the diagnosis.

Now if clinical equilibrium is established the patient is less apprehensive and more com-

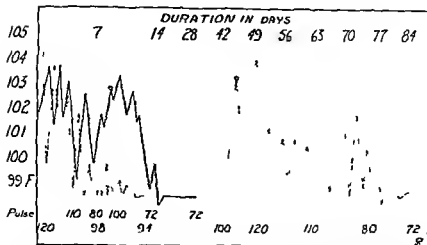


Chart 2 Superimposed diagrammatic temperature records of a parallel ischiopubic lesions which were treated by simple incision and drainage of the para osseous abscess. The solid and broken lines demonstrate the course of the disease after operation on the ninth and forty sixth day respectively. Delay in the latter was due to purulent regression of symptoms and premature discharge of the patient. The bony lesions in both instances regressed spontaneously.

fortable. The formerly sustained fever may now break and even touch the base line. The sedimentation rate decreases and the pulse rate is lower. The definite ascertainment of local suppuration is of primary importance and the surgeon's greatest responsibility. If surgery is to influence the further course of the disease at all it must depend upon reasonably early recognition of para osseous suppuration (Chart 2). The most important single diagnostic method for its detection is aspiration under anesthesia if necessary at the point of maximum tenderness.

ROENTGENOGRAMS

Adequate roentgenograms are indispensable for differential diagnosis and careful operative planning. The earliest sign (about the second week) appears as a localized osteoporosis and is soon followed by periosteal reaction, destruction, sequestration and bone production. Blurring of the skeletal epiphyseal and joint structures is soon observed under proper conditions. Any delay of osteoporosis is due to the calcific attempt at restriction of the pathological process and would indicate watchfulness and surgical restraint.

Careful technique and interpretation will indicate early relevant intrinsic and extrinsic

pelvic changes. The obturator foramen may be clouded by an abscess originating from the ischium. The fascial capsular and muscular distortions and disturbances of pelvic equilibrium are very significant. The former are due to active purulent or serous infiltration and distention. The latter are passively initiated by muscular imbalance but are later accentuated or fixed by active progressive destruction and loss of bony tissue and joint relaxations.

Static and mechanical distortions of the pelvic girdle are often delayed and sometimes prevented by the voluntary or enforced recumbency assumed by the patient, and sometimes by persistent preventive measures.

Unhooking (Fig 5) at the symphysis pubis results from sacro iliac joint lesions proper and is not always associated with subluxation of the latter. On the other hand destructive lesions of the synchondrosis (sacro ileitis) are characterized by a total lateral shift of the bony pelvis toward the unaffected side without pubic displacement (Fig 6). This is also associated with an upward displacement on the affected side especially after partial or total operative resection of the sacro iliac synchondrosis.

The sacro iliac region is notoriously difficult

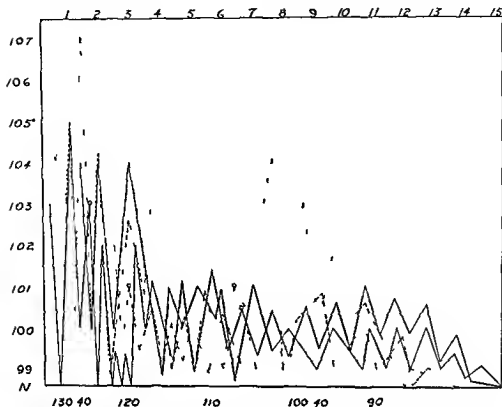


Chart 3 Superimposed diagrammatic temperature records of 4 parallel lesions. Broken lines indicate ischial and the solid lines iliac foci. Resections were performed in the second, third and sixth weeks of the disease.

to interpret roentgenographically. There are numerous variations within normal limits. The tendency toward spontaneous obliteration of the joint in older individuals is often observed. It is helpful to remember that the anterior and posterior margins of the sacroiliac joint, except in the very young, are distinctly separated on an anteroposterior plate, the anterior appearing laterally. In the very young both margins are practically superimposed. In any event careful comparative analysis with the unaffected side is essential for the recognition of initial manifestations (Fig 7).

Early perforation and egress of pus from any focus minimizes bony changes. Lesions beginning and continuing centrally either by contiguity or retrograde thrombosis, yield the most striking roentgenographic changes, the latter often resembling a "rotten ice" (Dr A. B. McGlothlan) appearance. A roentgenographic distinction between extension by retrograde thrombosis and contiguity is possible in lesions studied at intervals from the onset of symptoms.

The former occurs rapidly and results in a marked mosaic like breaking up of an entire segment of the bony pelvis on the basis of a pronounced general osteoporosis, which results finally in typical sequestrum formation. This is demonstrated best in instances affecting the wing of the ilium. The latter occurs more gradually, the advancing margins are preceded and accompanied by a reactive sclerosis and terminate finally in less typical exfoliation of bone. Extension by vascular mechanism is almost invariably associated with continued marked systemic manifestations while that resulting from contiguity is locally expressed. Sinus injection with a radio opaque solution in the later stages is an important aid to diagnostic localization.

TREATMENT

The treatment is based upon the primary and secondary control of the disease and patient as a whole (Table I). Primary control is essentially the medical or symptomatic management of the preclinical and systemic phases of the disease. Secondary control or

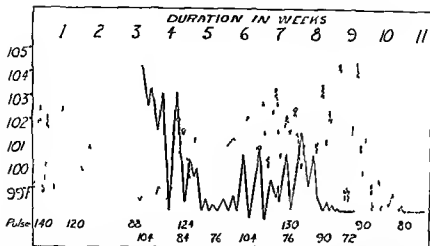


Chart 4 Superimposed diagrammatic temperature records of two lesions involving the sacro-iliac synchondrosis. The broken line represents an instance of isolated suppurative arthritis treated by simple incisions of intrapelvic and extrapelvic abscesses and the solid line a sacro-iliitis which was subjected to an initial conservative and a delayed radical operation.

operative treatment of the local lesion is dependent upon suppurative and residual phenomena.

Prevention and prophylaxis demand adequate treatment and guarded convalescence from focal and general infections, social hygiene and supervision of activities for those who might be expected to develop the disease. Since it has been found (Robertson) that topical skin infections do not excite an antitoxin increase in the circulating blood, administration of staphylococcus toxoid and/or antitoxin is suggested.

Careful observation and deliberation is the keynote of therapeutic management of the clinical level of the disease. The general condition of the patient and the presence or absence of pus must guide the conscientious surgeon on the basis of his experience. *Operation is contra indicated until definite suppuration has occurred* and evidences of clinical equilibrium are manifest.

The most aggressive measures are usually first directed against the systemic infection, by sedation, chemotherapy and immunotherapy (sulfanilamide or its derivatives and staphylococcus antitoxin), oral and parenteral fluids, repeated small transfusions, sedation and traction, the latter forming the first line of defense against impending deformity.

Theoretically it would appear that immunological therapeutic efforts should be most effective at the very inception of the disease. It may be axiomatically stated that traction and pelvic sling suspension will relieve subjective pain due to initially spontaneous muscle spasm whether they arise from pelvic girdle or hip joint lesions. Further progression of the lesion in either situation results in recurrence and intensification of symptoms due to increased intra-articular pressure in the latter and actual purulent infiltration of muscular compartments in the former.

Curiously enough early radical resection (Chart 3) did not diminish the period of convalescence as compared with those patients in whom it was delayed. Therefore, secondary control of the disease is inaugurated by a well timed and planned incision and drainage of the para-osseous abscess. The subsequent course of the lesion determines further operative indications. This is best exemplified in foci affecting the sacro-iliac synchondrosis (Chart 4).

Simple incision and drainage is usually followed by relief and continued improvement in sacro-iliac joint disease. The clinical syndrome soon recurs if the lesion originates from an osteomyelitic focus or if active extension takes place. Interval roentgenographic studies

es soon reveal unmistakable evidences of pararticular bony participation and its demarcation in due time. Now the urgency of radical intervention should be boldly accepted and satisfied. The feasibility of the latter procedures is not yet fully appreciated, but are seldom advisable before the second month of the disease (Chart 4).

Since secondary control of the disease is based on anticipation of local complications, Orr's general principles of treatment are instituted and persisted in from the onset of peripheral subjective symptoms. The radical measures so essential in the residual phases of the disease would not be otherwise feasible. Locomotor disturbances of mechanical origin and secondary infection can be most uniformly controlled by adequate rest of the parts and minimal interference with the postoperative sinus. The use of gauze impregnated with cod liver oil ointment (White) is suggested as an adjunct to the ordinary vaseline pack. Operative wounds must be left wide open. The tendency toward premature closure is remarkable in these deep seated lesions. The Roger Anderson splint as a preliminary and post operative preventive measure against deformity is also suggested.

A flare up demands the same serious consideration as that given to the initial evolutionary phases of the disease. Its evaluation and management will often tax the patience, judgment, and ingenuity of the surgeon to the utmost. When the flare up is associated with a marked systemic reaction the primary threat to the patient's life is reduplicated. The patient's volunteered subjective sensations should be carefully noted as an aid to diagnostic evaluation of the situation.

OPERATIVE HINTS

All initial incisions are made generously to facilitate maximum drainage of the bony focus. Iliopsoas and subiliacus abscesses are evacuated along the anterior superior border of the ilium. The subgluteal space is drained laterally. Occasionally pus from the sacro-iliac region is reached below the sacrosciatic notch or through Pettit's triangle. The fascial compartment of the thigh requires long lateral or posterior incisions. Successful achieve-

ment in radical operative methods depends upon careful preparation of the patient, control of hemorrhage, and convalescent supervision. Adequate procedures are essentially partial or total subperiosteal resections.

For the sacro iliac synchondrosis, the author employs the Bardenheuer-Picque technique. The incision follows through the fibrous origin of the gluteus maximus. Stripping is continued down to the vulnerable superior gluteal vessels which emerge under the greater sciatic notch. The posterior iliac flap is defined with the motor saw, or mallet and chisel. In partial or subtotal resection the heavy ridge of bone just above the sciatic notch is spared. The removal of affected sacral portions then continues as indicated.

Following Badgley's technique for lesions of the ilium, the entire external soft tissue flap is stripped down to the margin of the acetabulum through a Smith Peterson approach. Posteriorly, this continues to the greater sciatic notch, and is completed by exposure of the internal surface of the ilium down to the arcuate line. Affected bone is then removed piecemeal or *en masse* as necessary.

The author utilizes a posterior incision through the gluteal fold for lesions of the ischium. The lowermost fibers of the gluteus maximus muscle are retracted upward and laterally or may be partially incised. The sciatic nerve is next isolated and protected. The periosteum and ligamentous attachments of the tuberosity are incised vertically to the bone in the midline. Subperiosteal exposure proceeds to the inferior border of the acetabulum or pubis as indicated. Subperiosteal exposure proceeds to the floor of the acetabulum or pubis as desired.

CONCLUSION

More recent studies by Crossan, and others, of the mortality and morbidity of acute pyogenic hematogenous osteomyelitis of the long bones, challenge the validity of immediate operative intervention. Wilensky's classification of the disease, based upon end results of operation, however, is the first distinctive modern plan of treatment. His clinical grouping of cases, in reference to therapeutic indications, is classic and is the result of intensive

observation and investigation. Orr's principles of treatment, properly timed, solve the practical problems involved in the actual management of the disease and patient as a whole from the general surgical and orthopedic aspects.

Present day concepts of the therapeutic management of hematogenous osteomyelitis have evolved chiefly from an increasing knowledge and harmonious interpretation of the variable clinical life history of the disease, which finds adequate expression in the pelvic situation. The disease as it affects the pelvic girdle presents an apparently unique problem. The immediate diagnostic and therapeutic obstacles encountered have unexpectedly but definitely dovetailed divergent conservative and radical methods of operative treatment.

The practice of operation here on mere suspicion of the lesion is impractical and dangerous and should be condemned. Demonstrable suppuration remains the sole indication for initial operation in the early stages of the disease. The local and systemic benefit derived from a well timed simple incision and drainage operation is indisputable but is not always followed by a dramatic recession of symptoms. The disease may continue as a severe local or general infection until the defensive mechanisms of the body begin to establish controlling influences. Radical intervention belongs to the residual phases of the disease and is determined by the qualitative and quantitative state of the local lesion on its own merits.

Therapeutic control is dependent upon a reasonably early recognition of the disease but even more so the stage of development of the local lesion and its relation to the associated systemic factors involved. The disease is not a static process. Respectful observation of the lesion following seeding and the subsequent bacterial lag or period of adaptation is essential in the formulation and application of rational therapeutic measures.

A perspective of hematogenous pelvic osteomyelitis is herein presented from the viewpoint of its pathogenetic development. On this basis a clinical grouping of cases and their therapeutic management is possible which is in complete harmony with objective manifestations

of the disease and sound clinical judgment.

The following are illustrative case reports clinically grouped according to their stage of development on admission to the hospital and therapeutic management.

I ABORTIVE AND PRESUPPURATIVE

CASE 1. Velma B. aged 12 years suffered with abortive osteomyelitis of the ilium. Acute systemic onset began 5 days before admission to the hospital with severe pain in the right elbow and left hip region 2 days later. The temperature was 104 degrees F, and the white blood cells numbered 35,000. The lower humeral focus developed pus which was incised and drained on the fifth hospital day. The tenderness and infiltration over the posterior left ilium and eccentric hip spasm gradually subsided under traction. Patient made complete recovery. No recurrences were found 3 years later.

CASE 2. Glenn S. aged 13 years suffered from presuppurative osteomyelitis of the ischium. Ten days previously he experienced insidious pain and disability in the left hip. The white blood cells numbered 20,000 and the temperature was 100 degrees F. Examination showed edema and tenderness about the gluteal region and ischium. Incision revealed only serous fluid. The fever rose to 103 degrees F and remained irregular for several days. He was discharged practically healed 12 days later.

II NON SUPPURATIVE

CASE 3. Edward H. (courtesy of Dr. H. K. Wallace) aged 6 years had a non suppurative lesion of the ischium. Sudden onset occurred 2 weeks previously with chills, fever and pain in the left hip. In one week all symptoms except slight perineal discomfort and moderate fever had subsided. Physical examination revealed digital tenderness along the ascending ramus of the ischium and eccentric hip spasm. X-ray film showed definite osteoporosis, destruction and periosteal reaction affecting the tuber ischii. Spontaneous clinical recovery and bony reorganization occurred in about 3 months following a period of recumbency without operative intervention.

III SUPPURATIVE

A. Cases in which there was no balance between the systemic and local infection. Fatality was due to uncontrollable complications.

CASE 4. Vernon M. aged 15 years had a suppurative lesion of the ischium. The hip joint was surgically exposed on the day of admission because of a mistaken diagnosis. Operative treatment was delayed. Sudden systemic onset occurred 4 days previously with pain in the right hip region. The white blood count was 24,000 and the temperature 104 degrees F. There was localized tenderness in the adductor region of the affected side associated with

eccentric muscle spasm. The blood culture was positive for the *Staphylococcus aureus*. A tibial metastasis developed 12 days after patient was admitted to the hospital. Forty six days after onset a huge abscess was incised and drained from the posterior compartment of the thigh. The patient died 3 days later. Autopsy revealed massive necrosis of the ischium, destruction of the hip joint, an intrapelvic abscess and multiple visceral metastases.

CASE 5. Leland E., aged 15 years, had an involvement of the ischium. Early operation did not prevent fatality. Four days previously he suddenly developed coxalgia, chills, fever and delirium. Ischial tenderness and eccentric muscle spasm of the hip were noted. The white blood count was 18,600. The blood culture was positive for the *staphylococcus*. Two days later incision and drainage of the abscess was performed. After a brief period of general improvement he became worse, coughed up bloody sputum and died in the fourth week of his illness. No autopsy was performed.

B. Cases in which systemic and local balance had occurred

1. Conservative operative treatment was inadequate

CASE 6. John B., aged 7 years, had an infection of the ilium. The patient suddenly became ill 10 days previously with moderate fever and severe hip pain. The temperature was 102 degrees F., and the white blood cells numbered 34,400. Examination indicated marked tenderness about the iliac wing and evidences of fluctuation over the anterior superior spine. X-ray films showed osteoporosis and periosteal reaction at the anterosuperior border of the ilium. Incision with drainage of the abscess was done. The *staphylococcus* was recovered from the pus. The wound continued to drain profusely and patient exhibited a moderately severe septic course for about 6 weeks. Subsequent interval clinical and x-ray check up over a period of several years showed extension and activity of the local lesion. No further operative treatment was however performed.

2. Conservative operative treatment was adequate

CASE 7. Raymond J., aged 13, had an ischiopubic and femoral lesion. Acute septic onset occurred 6 days previously with bilateral pain in the thighs, rectum and scrotum and painful reference to the medial border of the left knee. The temperature was 103 degrees F. and the white blood count was 20,800. Relevant findings were general pelvic tenderness, eccentric hip spasm and tenderness over the left lower medial femoral epicondylar region. Rectal tenderness was maximal at the ischiopubic junction. Three days later simple incision and drainage of both pelvic and femoral foci resulted in an uneventful convalescence, recovery and spontaneous bony reorganization of both lesions.

CASE 8. Ldith S., aged 15 years (Fig. 5, Chart 4, broken line) had an isolated suppurative sacro iliac arthritis. During the course of an induced septic abortion she suddenly complained of pain in the left hip region. Physical examination elicited eccentric muscle spasm and digital tenderness over the left mid ilium. The temperature subsided in 20 days and was followed by a 10 day period of comparative comfort in traction. Two weeks later cloudy fluid was aspirated from the hip joint. Since no organisms were culturally recovered, traction was continued. Roentgenograms were inconclusive until slight unhooking occurred about 3 weeks after onset of local symptoms.

One month later an iliopectineal abscess became evident and was incised and drained. Cultures now grew long chained non hemolytic streptococci from the abscess and hip joint. Subsequent drainage was profuse. In another 3 weeks the fever again rose to 105 degrees F. which subsided after a huge secondary subgluteal abscess was also incised and drained. Convalescence henceforth was smooth and sound spontaneous healing of both joints occurred in about 3 months. The sacro iliac joint fused spontaneously. The hip joint showed no residual untoward effects. There was no recurrence after an obstetric delivery about 1 year later.

IV. RESIDUAL

Adequate 2 stage radical operative treatment

CASE 9. Helen S., aged 20 years, had a sacro ilitis. Sudden onset occurred 4 weeks previously with initial symptoms of an acute infectious disease and low back pain which radiated to the medial side of the right knee. The gross relevant physical findings were loss of weight and right hip deformity. There was marked tenderness over the right sacro iliac region posteriorly with infiltration of the soft parts. A large tense tender mass was palpable in the right iliac fossa extending to Poupert's ligament. The sedimentation rate was rapid. The white blood count was 10,650 and the temperature was 100.5 degrees F. The x-ray film showed typical destruction and sequestration of the sacro iliac synchondrosis. Initial simple incision and drainage of the iliopectineal abscess was followed in a week by a subtotal resection. The subsequent convalescence was uneventful and recovery occurred in 4 months with partial bony regeneration of the affected region.

CASE 10. Florence K. (Chart 4, solid line) aged 21 years had a sacro ilitis. Three weeks previously she suddenly experienced chills, fever, sweats, nausea, and vomiting and severe persistent pain in the left hip region. The temperature was 102.5 degrees F. and the white blood count was 32,650. The left hip was semiflexed and exhibited eccentric muscle spasm. Maximum tenderness over the left sacro iliac region was confirmed by digital rectal examination. The blood culture grew gram positive cocci in groups and in chains after 4 days of incubation.

tion on 2 occasions. The sedimentation rate was moderately increased.

Under symptomatic and mechanical supervision the general and local condition was improved. On the sixth hospital day (1 month after onset of symptoms) a demonstrable subiliac mass was incised and drained and was attended by local and general improvement. Three days after operation painful symptoms recurred. Interval roentgenographic investigation indicated unmistakable evidences of sacro ileitis. Eleven days after her first operation (about 6 weeks after onset of illness) she was subjected to a total sacro iliac resection. The convalescence was uneventful and healing occurred in about 5 months.

REFERENCES

1. BADGLEY, C. E. Osteomyelitis of the ilium. *Arch Surg* 1934 28 83.
2. CHANDLER, F. A. Pneumococcal infection of the sacro-iliac joints complicating pregnancy. *J Am M Ass* 1933 101 114.
3. FREIBERG, J. A. and PERLMAN, R. Pelvic abscess associated with acute purulent infection of the hip joint. *J Bone & Joint Surg* 1936 18 417.
4. KEY, A. Straight incision for arthrodesis or drainage of the sacro iliac joint. *J Bone & Joint Surg* 1937 19 117.
5. KULLOWSKI, J. Pyogenic osteomyelitis of the sacro iliac joint. *Am J Surg* 1934 23 305.
6. Idem. Pyogenic osteomyelitis of the pelvis. *Arch Surg* 1937 35 571.
7. Idem. The Orr treatment of pyogenic osteomyelitis. *Ann Surg* 1936 103 613.
8. Idem. Therapeutic indications in hematogenous osteomyelitis. (In press).
9. LEFISCARO, J. B. Pathological dislocation of the sacro-iliac joint. *J Bone & Joint Surg* 1936 18 524.
10. Idem. Suppurative arthritis of the sacro iliac joint. *Ann Surg* 1936 104 289.
11. McWHORTER, G. L. Osteomyelitis of the ischium and pubis: new operative technique. *Surg Gynec & Obst* 1920 49 205.
12. MITCHELL, H. J. Partial resection of the ischium. *J Bone & Joint Surg* 1935 17 166.
13. MILGRAM, J. E. Surgery of suppuration of the thigh. *J Am M Ass* 1932 98 117.
14. NATHAN, F. W. Differential diagnosis and treatment of acute osteomyelitis of upper end of femur involving hip joint. *Surg Gynec & Obst* 1932 54 52.
15. SMITH, PETERSON, M. A. *Am J Orthop Surg* 1917 15 593.
16. WILENSKY, A. O. Case of acute hematogenous osteomyelitis with spontaneous recovery. *Surg Clin N America* 1935 15 495.
17. Idem. Classification of acute hematogenous osteomyelitis as determined by therapeutic indications. *Arch Surg* 1937 34 320.
18. Idem. Osteomyelitis of the pelvic girdle. *Arch Surg* 1938 37 371.
19. YOUNG, I. Acute osteomyelitis of the ilium. *Surg Gynec & Obst* 1934 58 986.

CLINICAL SURGERY

FROM THE DEPARTMENT OF SURGERY, NORTHWESTERN UNIVERSITY

THE MIKULICZ OPERATION—DEVELOPMENT AND TECHNIQUE

R W McNEALY M D F A C S, and MANUEL E LICHTENSTEIN, M D, F A C S,
Chicago, Illinois

IN reviewing the origin and development of what is known as the "Mikulicz operation," several distinct contributions are recognized as having pointed the way to its definitive technique. The Mikulicz operation consists of 3 distinct parts: first, the exteriorization of the loop of the diseased bowel; second, the formation of a double barreled colostomy; and third, the elimination of the spur with the re-establishment of continuity of the bowel. Each of the steps in this operation was accomplished long before the era of antiseptic surgery.

Early literature⁽⁴⁾ records examples of "colostomy necessitatus" in which bernaition of a segment of intestine was followed by sloughing of the external loop with spontaneous formation of an external colostomy. In this manner, intestinal obstruction was overcome by a natural process. Thus, the first two parts of the Mikulicz operation entail the application of a principle that had been pointed out by Nature's method. The third part of the operation, destruction of the spur with the restoration of continuity of the bowel, is of more recent origin and dates back to a little more than a century ago.

In J. Sving Dorsey's *Elements of Surgery* published in 1813, volume 7, page 67, there appears the following:

"In a patient with artificial anus at the Pennsylvania Hospital Dr. Physic performed an operation which will probably be found to afford complete relief in many similar cases. The sides of the intestine in this instance were consolidated laterally, or in Mr. Cooper's language like a double barreled gun. In order to ensure this union a ligature was passed through the intestine and suffered to remain a week keeping its side* in close contact, after which Dr. Physic cut a hole in the side of the intestine where the two portions had thus united and by stopping the external orifice the faces regained their natural route the external aperture was afterwards healed and the patient relieved from this most loathsome complaint, he has for several years enjoyed perfect health."

In 1828, Dupuytren recorded observations made in 1813 on a patient who developed an artificial anus with two stomas following sloughing of a strangulated hernia. He later observed several such cases and devised an instrument in the nature of a crushing forceps which he called an enterotome. This was used to crush the spur without danger of opening into the peritoneal cavity. This clamp has been in use for many years and many modifications have been made.

One can see from the foregoing that all of the principles involved in the Mikulicz operation were well established half a century before the era of antiseptic surgery, and another 25 years passed before this ensemble of principles was made use of in the further development of surgery of the large intestine.

In 1879, several variations in the technique of large bowel resection were recorded.⁽¹³⁾ Billroth did a bowel resection with closure of the distal end; the proximal end was brought out as a colostomy. During the course of a difficult resection, Schede brought out both ends of the bowel from the wound when he found it impossible to approximate them by suture. This was an improvised manner of terminating a resection of the colon. Gussenbauer of Liege and Martin of Hamburg each successfully removed a sigmoidal tumor with its mesentery and glands leaving a double barreled colostomy.

In 1880, Czerny resected a tumor and successfully exteriorized the afferent and efferent loops of bowel. In 1881, Bryant in attempting a lumbar colostomy for a stricture of the descending colon due to a scirrhous carcinoma, exteriorized the affected loop of bowel, resected the tumor and implanted the stoma in the lumbar wound.⁽¹⁵⁾

In 1884, Heineke described and illustrated in his *Compend of Surgical Operations* a multiple stage operation for resection of the colon. In the

first stage the tumor was brought out and the mesentery to that portion of the bowel harboring the tumor was severed. The proximal and distal loops were placed side to side. The tumor was then removed and the bowel was sutured into the abdominal wall. Later closure of the openings was done by freeing the stomas after crushing the spur with intestinal forceps. This was the first time that deliberate division of resection of colon carcinoma into three stages was suggested. There is no reference however that this graded operation was actually performed on a patient.

The time interval that elapses between the exteriorization of the diseased loop of bowel and the establishment of the double barreled colostomy is of importance in permitting the development of protective adhesions about the operative site. When in 1883 Maydl advocated the two stage left iliac colostomy with opening of the bowel on the fourth day, he emphasized this important feature of the modern operation.

In England Davies Colley promulgated a similar idea. At a meeting of the Clinical Society of London in March 1885, the secretary recorded:

Mr Davies Colley further submitted that a similar plan might be desirable in cases of tumor of the large intestine. The loop containing the growth might be left protruding from the wound for a few days and then removed by knife, cautery, or some caustic agent. This was the first suggestion that the tumor be left *in situ* until protective adhesions develop. At the present time obstructive resection is practiced with immediate removal of the diseased bowel. Contamination however is avoided by keeping the cut ends of the bowel closed with clamps until protective adhesions have developed.

In 1890 Bloch of Copenhagen published work done in 1890. He brought out a tumor of the sigmoid flexure in a patient with intestinal obstruction. The proximal end was opened for the purpose of decompression. The tumor was resected several days later. After 4 months the wound edges were freed and an end-to-end anastomosis made. The patient recovered temporarily but died after 12 months from liver metastasis. This is the first reference to a case operated on deliberately by the three stage method. Bloch recorded several such cases of exteriorization of a tumor with subsequent resection and later restoration of bowel continuity. While at first he employed his method only in cases of mobile bowel, he later used this method in cases in which the colon needed mobilization. Thus to Bloch rightfully belongs the credit for first having carried out this three stage type of operation for colon resection.

In 1893 Paul of Liverpool reported in the *British Medical Journal* some work he had begun in 1892. Following an unsuccessful case he writes:

I therefore thought out and determined to put in practice the following mode of operating in the next case. First to excise the strictured portion of bowel as in the last two cases, then to suture together the cut edges of the mesentery and the adjacent sides of the two ends of the colon in such a manner that they would adhere together for about three inches in the position of the two barrels of a double barreled gun. If this succeeded the spur might be demolished without the slightest risk of peritonitis and to such an extent as to insure a free passage and easy closing of the artificial anus.

Later Paul reported on 11 consecutive successful cases.

In 1900 Mikulicz described the details of an aseptic method for exteriorizing a tumor bearing segment of the bowel. The mesentery to this segment was severed and the loops were united for the purpose of building a spur. Later the tumor was removed and subsequently the spur was broken down to restore continuity of the lumen of the bowel. He emphasized that the entire operation up to the complete closure of the abdominal cavity, be carried out in an aseptic manner. The mesentery from which the tumor bearing section of bowel was suspended also was resected. This enlarged the scope of the operation.

Anschutz a pupil of Mikulicz pointed out that both Paul and Mikulicz demanded removal of the mesentery with formation of a spur by suturing the 2 intestinal limbs leading to the tumor and the removal of the spur by the bloodless method of crushing.

In 1903 Mikulicz visited the United States. On May 13 in Washington, D. C., at the annual meeting of the American Surgical Association he read a paper in which he discussed the stage operation for large bowel resection. He stated that of 24 cases treated in stages and examined 4 years after operation 9 were without recurrence. He continued: Among these nine are several that have been under observation much more than 4 years. I operated on my first case 17 years ago (1886) while I conducted the clinic at Krakow.

It is apparent that the Mikulicz operation was a rather natural outgrowth of the trial and error method which has given birth to so many of our present procedures. The Mikulicz operation had its inception early in the history of colon surgery. It took more definite form as abdominal surgery became less hazardous and at the turn of the century it was established as a definite principle. Mikulicz himself did not seek credit as the author.

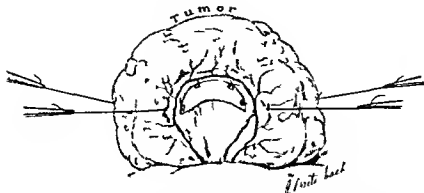


Fig 1 Preservation of marginal vessel to site of resection Limits of resection Limits of resection determined and fixed by sutures placed on mesenteric and antimesenteric borders of exposed bowel (primary sutures)

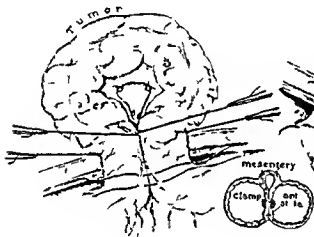


Fig 2

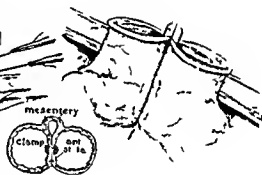


Fig 3a

Fig 3



Fig 4

Fig 2 Formation of spur Longitudinal bands approximated for a distance of 3 inches when possible No attachment of bowel to abdominal wall Bowel may be resected by clamping at level of primary sutures The vascularity of the stoma has been assured by the preservation of the vessels to this site

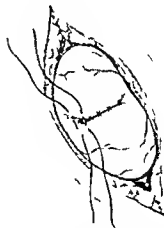


Fig 5

Figs 3 and 4 Crushing of spur with re-establishment of continuity of bowel 3a Note position of mesentery site of clamp for crushing spur and suture on anterior striae
Fig 5 Eight to 10 weeks later closure of stoma after thorough freeing from abdominal wall Note closure made in transverse axis of bowel

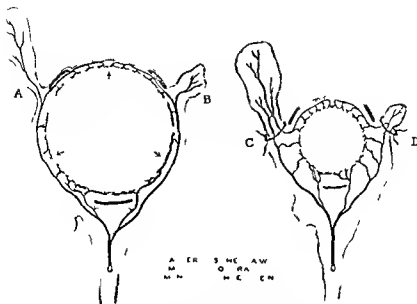


Fig. 6 Distended bowel. Slack in vessels A and B removed

Fig. 7 Contracted bowel. Ligation of appendices epiploicae at C and D. Blood supply to bowel

of this procedure but modestly gave credit to those whose previous work pointed the way (11). The wide publicity which was given this operation by so distinguished a surgeon as Mikulicz has done much to advance this field of surgery and warrants the continued use of his name in connection with this multiple stage operation.

The success of this operative procedure is dependent upon the careful observance of the principles already established. While there are several methods that may be employed to resect the bowel according to the Mikulicz plan of operation we wish to present some details of a method which we regard as important to avoid the dangers incident to the technical features of the operation.

OPERATIVE PROCEDURE

Exteriorization of the transverse colon and the sigmoid colon is facilitated by the presence of a mesentery to these portions of the large bowel. Other sections of the colon require mobilization by incision of the parietal peritoneum on the lateral side of the bowel wall. In 1932 Lahey gave an excellent description of the removal of the right side of the colon based on this method.

Limits of resection. Following mobilization the limits of resection of the bowel are clearly demarcated by the application of non-penetrative sutures on the mesenteric and on the anti-mesenteric borders of the bowel (Fig. 1). These sutures clearly define the part that is to be re-

moved and establish the level to which the blood supply is to be preserved. The marginal vessel is sought for and preserved while the remainder of the mesentery to the portion of bowel to be resected may be divided. While the illustration (Fig. 1) shows this division of the mesentery adjacent to the bowel it may be possible to sever the mesentery at a greater distance from the bowel.

Formation of the spur. The spur (Fig. 2) is made by approximating the two limbs of the bowel below the level of the demarcation sutures. The longitudinal bands are approximated for a distance of at least 3 inches, preferably more when possible. The limbs are rotated toward the umbilicus away from the lateral abdominal wall so that the blood supply enters at a point remote from the site of suture (Fig. 3a).

Closure of the abdomen. No attachment of the approximated limbs of bowel is made to the abdominal wall. The peritoneum is sutured with catgut fairly snugly about the protruding limbs. The fascia is closed with interrupted catgut sutures. The skin is then loosely closed. When possible the limbs protrude through muscle bellies. This is an aid to the subsequent closure of the resulting colostomy.

Removal of the diseased section of bowel. Following careful closure of the abdominal wall 8 inch forceps or crushing clamps are applied on both limbs of the bowel at the level of the demarcation

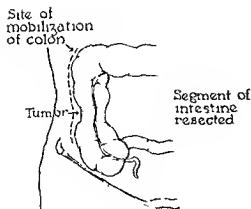


Fig 8

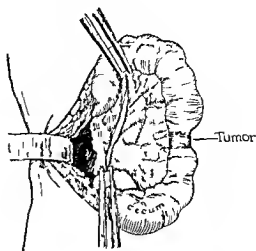


Fig 9

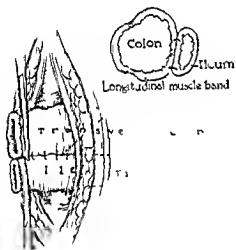


Fig 10



Fig 11

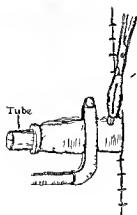


Fig 12

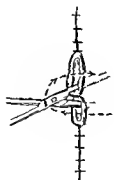


Fig 13



Fig 14

Figs 8 to 14 Resection of the right side of the colon as described by Lahey

sutures. The presence of these sutures makes it possible to note accurately the level to which the blood supply has been preserved. With a cautery the bowel is severed from the forceps. There is an advantage in the immediate removal of the exteriorized bowel in that the disease is removed

from the body at once. However, the clamps produce a temporary obstruction. The proximal clamp may be removed within 36 to 48 hours from a portion of the bowel to permit the escape of gas. The distal clamp remains attached for a longer period to assist in holding the bowel well up in

the wound. On or about the seventh day all clamps are removed and a double barreled colostomy is present.

Crushing the spur. One week following the resection digital examination of the spur is made and a crushing clamp is applied with one blade on each side of the spur at the site of the approximated bowel (Figs 3 and 31). This crushing clamp will loosen and lie free when the crushed portion of the spur has sloughed out. If some of the spur remains it too is crushed until finally none of the spur remains. The patient then has a single barreled colostomy in continuity (Fig. 4).

Closure of the colostomy. After 8 to 10 weeks during which time the abdominal wall has become immunized against the organisms present locally the stoma is freed from the abdominal wall. This includes removal of the skin edge about the colostomy and freeing the bowel from the peritoneal attachments. The bowel is closed in its transverse axis so as not to constrict its lumen. Deep interrupted catgut sutures are placed. The seromuscular layer is approximated accurately with interrupted fine silk sutures (Fig. 5). The bowel is replaced within the peritoneal cavity. The abdominal wall is closed with interrupted sutures of braided silk passing through the full thickness of the abdominal wall.

The appendices epiploicae have a definite relationship to the blood supply on the antimesenteric surface of the bowel (14) (Fig. 6). Those present at the site at which the diseased bowel is covered should be carefully inspected before they are removed. The placing of ligatures too closely to the base of these fatty tags may result in necrosis of a portion of the wall of the bowel.

Resection of the right side of the colon is well shown in the illustrations from Lahey. In order that obstruction may be relieved immediately following removal of the exteriorized segment of the bowel the ileum is cut at some distance from the abdominal wall and a rubber or glass tube is

inserted (Fig. 12). This may be attached to rubber tubing and a container so as to avoid soiling the wound of exit. A similar plan has been described by Woodhall in the treatment of ileocecal intussusception with extensive damage to the invaginated bowel. A lateral anastomosis just proximal to the exteriorized loop of bowel prevents loss of fluids, a matter of considerable importance in infants.

BIBLIOGRAPHY

1. ANSCHUTZ W. Beiträge zur Klinik des Dickdarmkrebses. Mitt. a. d. Grenz d. Med. u. Chir. 1907 Suppl. 3.
2. BLOCH O. Extra abdominal treatment of intestinal cancer (exclusive of the rectum). Zentralbl. f. Chir. 1892 p. 628.
3. DAVIES COLLEY. Clinical Society of London meeting March 13, 1885. Lancet 1885 1: 522.
4. DINCKEL HILSON. The origins and evolution of colostomy. Brit. J. Surg. 1934 22: 142.
5. DUPUYTREN G. Mémoire sur une méthode nouvelle pour traiter les anus accidentels. 1828.
6. HILKEKE W. H. Compendium der chirurgischen Operations und Verbandslehre. 3d ed. Erlangen E. Besold. 1884.
7. LAHEY F. H. Resection of the right colon and anastomosis of the ileum to the transverse colon after the Mikulicz plan. New England J. Med. 1932 206: 315.
8. MADEL K. On the technique of colostomy. Zentralbl. f. Chir. 1888 15: 433. Albert. Lehrb. d. Chir. Vol. 3. 3d ed. Leipzig. Urban und Schwarzenburg. 1885.
9. MIKULICZ J. Surgical therapy for carcinoma of the large bowel. Verhandl. d. deutsch. Ges. Chir. f. Chir. 1902.
10. Idem. Small contributions to the surgery of the intestinal tract. Boston M. & S. J. 1903 148: 617.
11. MIKULICZ J. and KAUSCH W. Tumors of the stomach and intestine. Bergmann. Bruns. Mikulicz. A System of Practical Surgery. Edited by W. T. Ball. Vol. 4 p. 48. Philadelphia. Lea Bros.
12. LAUL I. T. Colectomy. Brit. M. J. 1895 1: 1139.
13. KANAKIN F. W. How surgery of the colon and rectum developed. Surg. Gynec. & Obst. 1937 64: 704.
14. REICHEL P. and STAEMMLER M. Intestinal neoplasms. Neue Deutsche Chir. 1933 33b: 277.
15. SMITH GREIG. Abdominal Surgery. Vol. 2 p. 590.
16. WOODHALL B. Modified double enterostomy (Mikulicz) in radical surgical treatment of intussusception in children. Arch. Surg. 1938 36: 989.

THE SURGICAL TREATMENT OF EXOPHTHALMIC GOITER

EUGENIO BERNABEO, M D, Bologna, Italy

EARLY intervention, generous and radical excision of thyroid tissue, associated with accurate pre operative medical preparation, can be considered today as the therapeutic measures of choice for patients afflicted with the Flajani Basedow syndrome. Close collaboration between the medical man and the surgeon exact evaluation of the symptoms and findings by both, and the prompt substitution of surgery when medical measures prove inefficient, are the fundamental concepts which should guide us in the treatment of this condition.

The physician who gives his patient too much hope from the use of conservative measures is indeed doing a great wrong just as much so as the surgeon who believes that the only salvation for the patient is radical removal of the thyroid tissue. From the very beginning of treatment the physician must make the patient realize that eventually surgery may be necessary and likewise the surgeon must not fail to avail himself of all therapeutic and prognostic aids in arriving at his decision as to treatment.

To persist in medical therapy which, after sufficient time has elapsed, fails to show evidence of success is, in our opinion, the same as condemning the surgical treatment when it is used in a patient suffering from a severe thyrotoxic crisis before he is given proper pre operative preparation. We never operate upon a patient suffering with the Flajani Basedow syndrome until he has been placed in the medical ward where he may receive the benefit of the necessary pre operative measures and where the environment permits the complete psychic rest so necessary in this disease. We never operate until the patient has received pre operative treatment with diiodotyrosin, cardiolinetics, and sedatives and has been allowed complete rest, free from psychic excitement. The rapid pulse is corrected and the basal metabolic rate and general condition are improved.

According to the old conception, patients in grave thyrotoxic states with fever and cachexia were operated upon but operation usually was delayed, with the result that death occurred. Today intervention is considered advisable in all forms of hyperthyroidism which either are developing or are stationary and in which, after medical care,

patients fail to respond. Surgery is also advised in those less grave cases in which the patient's social or economic condition does not allow him to receive proper medical care and above all when he needs physical and psychical rest.

We remove the thyroid tissue in two stages. Resection of the right lobe, which is usually most affected, is done first. After one or more months, depending on the case, the left lobe is resected. It is our practice to use this precaution to reduce the dangers of postoperative toxic conditions. This method almost always assures success in the severe forms of the disease. In our experience results were so favorable in 6 per cent of the cases that it was not necessary to remove the second lobe. After resection of the first lobe we have always observed a diminution in the neurovegetative and psychic irritability of our patients, cessation of the profuse diarrhea, and notable improvement in the basal metabolic rate—at least enough to make it possible to do the second operation under better conditions and with much less danger. The two stage operation has the great advantage of guiding us as to the quantity of thyroid tissue to excise.

While we are very generous in our resection of the right lobe, we base our judgment as to the approximate quantity of thyroid to be removed



Fig 1 The head is in hyperextension the tie shaped incision is outlined on the anterior surface of the neck, one or two fingerbreadths above the fork of the sternum.

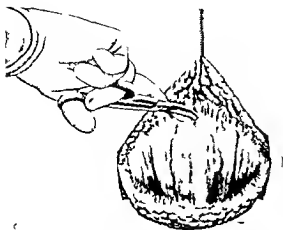


Fig. 2 With the help of the scissors the superior cutaneous limb is detached

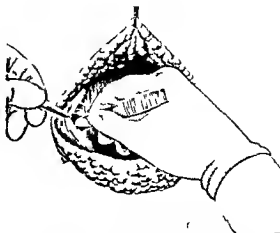


Fig. 3 The median cervical sponeuro: once cut the sternomastoid muscles are pulled laterally

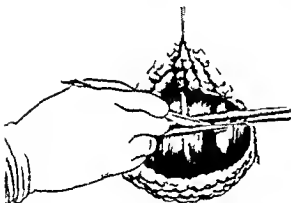


Fig. 4 The infrahyoid muscles are cut transversely between two Kocher forceps

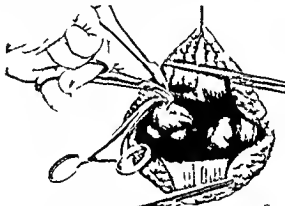


Fig. 5 Ligation and section of the superior thyroid artery and of the peduncle

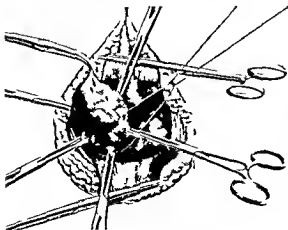


Fig. 6 A strong silk suture is applied to the base of the ligated thyroid lobe. The Chaput crown prevents its escape

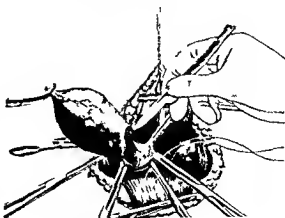


Fig. 7 The thyroid lobe is cut some millimeters above the Chaput while a strong finger forceps holds the unknotted thread

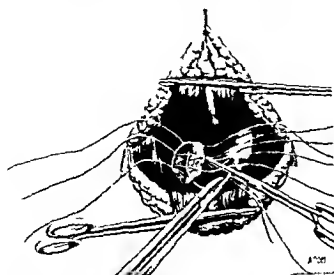


Fig. 8 Suture of the residual stump with separated catgut sutures

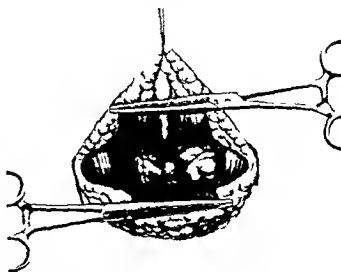


Fig. 9 The residual stump of the thyroid is sutured and the silk suture has been taken away

from the left lobe on the residual symptoms of the patient. Our aggressiveness in the second stage, therefore, depends on the individual in question.

We prefer subtotal extracapsular resection to partial resection as this type of intervention offers distinct advantages, especially if done with the technique we use.

For the anesthetic, we use novocain administered locally, preceded by basal narcosis. This has always answered our purpose even in those forms of thyrotoxicosis in which patients are highly nervous and excitable. In fact in our patients thanks to the use of basal narcosis, it has always been possible to suppress or calm the psychic shock and to carry out the surgical operation while they are in perfect health.

OPERATIVE TECHNIQUE

Step 1 For incision of the skin and the prethyroid muscles the patient is placed in the supine position with the head held in hyperextension by means of a roll of linen placed under the nape of the neck. The field of operation is prepared. With the usual formality we infiltrate the skin, subcutaneous tissues, and muscular layers with novocain along the line to be incised. The novocain used contains small doses of adrenalin. In spite of the diversity of ideas regarding the contraindications for the use of adrenalin we have always used it and have found that, rather than having a damaging effect, it is of great operative advantage. We practice the horizontal tie or cravat incision (Fig. 1) on the anterior surface of the neck, about one or two fingerbreadths above the fork of the sternum along one of the cutaneous folds.

When the two stage operation is to be performed, that is when only one lobe is to be re-

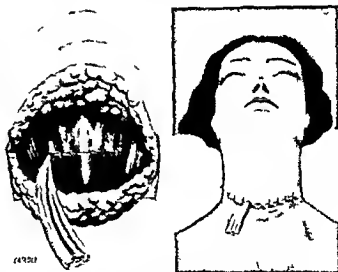


Fig. 10 Rubber drainage is shown in position site

moved, we prefer a less extensive incision, cutting only that side on which we are to intervene. The superior cutaneous border is opened (Fig. 2) and after careful hemostasis of the cutaneous wound the deeper muscular aponeurosis appears.

The medium cervical aponeurosis is incised along the sternocleidomastoid. We can then displace these muscles laterally in such a way as to traverse the infrahyoid muscles. If the thyroid is small these muscles are dilacerated in the direction of their fibers; if, instead, the goiter is large we prefer a more ample pathway and so section the infrahyoid muscles transversely by means of two Kocher forceps (Fig. 4).

Step 2 The superior peduncle is ligated and the glandular lobe is dislocated. When the thyroid gland has been uncovered, we grasp it with finger forceps and catgut suture and section the superior

thyroid artery and the peduncle of the superior lobe (Fig 5) which is now easily visible, thanks to the previous incision. Once the ligature is made we proceed with the luxation of the thyroid lobe releasing it with delicate digital maneuvers and using scissors when necessary.

Step 3. The lobe is resected and the hemostatic suture is placed. The lobe is drawn out as far as the base a strong silk suture strong enough to answer the purpose of temporary hemostasis is applied. This suture is not tied but once constriction is obtained the lobe is held firmly with a large finger forceps until several Chaput pinchers are applied the silk suture holding the gland parenchyma so that it does not slip.

The application of this hemostatic suture has many advantages: it permits the operator to proceed more rapidly; it protects and helps prevent injuries to the recurrent nerve and to the parathyroid glands; and above all it permits the operation to be carried out with a minimal loss of blood. Keeping a few millimeters above the Chaput pinchers the lobe may be sectioned with out the loss of a drop of blood. The section includes about nine tenths of the parenchyma of the gland.

Step 4. Suture of the residual thyroid stump and anatomical reconstruction of the walls constitute the fourth step. Once the lobe is resected the temporary hemostatic suture is found still in place and the residual gland is sutured through and through with catgut stitches passing some millimeters from the original hemostatic suture. Generally 4 or 5 stitches are sufficient (Fig 6). These are tied only after the Chaput pinchers and the original suture have been removed. We then proceed to ligate the separated stitches to which a few others may be added to the rubber drainage (we roll up a tiny piece of surgeon's glove for this purpose). If the goiter is large this drain is put in the thyroid site in close contact with the remaining lobe before proceeding with the suture of the infrahyoid muscles—if they have been cut—and the suture of the skin.

Immediately after the operation we advise that the patient be placed in the half sitting position and given no food except liquids rich in carbohydrates. Drainage is removed on the second or third day and the cutaneous stitches are removed on the fifth or sixth day. Medical treatment to sustain the heart action and to relieve excitement of the patient is given. We generally give diiodotyrosin 10 per cent polybromural solution morphine camphoric oil uabuin and glucose hypodermoclysis to avoid thyrotoxic complications.

The systematic use of the technique described has made it possible for us to avoid the most frequent complications after thyroidectomy. In fact we have never observed either paresis or paralysis of the recurrent nerves; we have had no cases of parathyroid tetany and we have not experienced large loss of blood from injuries to the inferior thyroid artery. Moreover we have never observed any thyrotoxic phenomena.

SUMMARY

We have attempted to give a description of the accurate preparation of the patient to be operated upon to state the precautional measures of the two stage operation and the steps in technique. We have never observed in our patients who are less than 100 in number any notable postoperative complications. Our operative mortality is nil in spite of the fact that we have operated upon patients with high basal metabolism rates in whom the general condition appeared very serious.

In various periods since operation all our patients without exception show the benefit of operation and all claim to be completely cured (a slight exophthalmus being the only residual sign) and they all have been able to resume their regular occupations.

In conclusion it can be said that timely generous and radical surgical therapy can cure Flajani Basedow disease and that it gives results far more brilliant than those attained with other methods of treatment.

CLINICAL ASPECTS OF SACROCOCCYGEAL TERATOMAS

LAWRENCE CHAFFIN, M.D., F.A.C.S., Los Angeles, California

THE caudal region of the fetus is a favorite location for congenital deformities. Abnormalities, so situated, have been attributed now and then to fetal inclusion, the engulfing of one ovum by another. Much more frequently, however, the most plausible explanation of the defect assumes that it was caused by amniotic adhesions. In the very early stages of development the rump of the embryo comes into close proximity with the amnion. Even temporary adhesions to this membrane may invoke structural alterations in the embryo which will remain permanently, unless they are amenable to surgical treatment. Prominent among these abnormalities is spina bifida, less common are such neoplasms as lipomas, dermoid cysts, and teratomas. At times the peculiar location of the appendage, its conformation, and a covering with hair, more or less profuse, are circumstances which have led to its misinterpretation as a "true tail." Hasty observations of this kind have furnished the material for an entertaining chapter of folklore.

"The most remarkable stories have been told and have found credence in these the significance of caudal appendages has been variously interpreted. On the one hand, a tail has been considered a distinction of the highest degree, even a mark of divine descent as in the case of the Rawas of Poorbunder, on the other hand it has usually been looked upon as a curse or a stigma of degeneration." Prof. Ross G. Harrison,¹ who has just been quoted, himself described a case of "soft tail" in a boy, prefacing his essay with an excellent resume of our knowledge of the occurrence of tails in man. At present anatomists do not depend upon the unaided eye for the study of these growths, and the microscope has robbed them of any claim they may have had to consideration as relatives of the simian tail.

From the calculations of Calbet and Fochier, it appears that sacrococcygeal tumors of the newborn may be expected once in approximately 34,500 births. Hansmann and Berne collected 26 cases of this variety of teratomas, reported between the years 1924 and 1930. Subsequently descriptions of 46 cases have been published.²

Further reference to the material available in the literature will be made especially in connection with the question of treatment, an important problem in spite of the fact that surgeons do not have to face it very often. One fifth of these infants are stillborn in consequence of difficulties in their delivery, others, born alive, perish during the early days of the postnatal period.

CLINICAL STUDY

Girls predominate among the infants afflicted with sacrococcygeal teratomas, of 59 cases in which the sex was specified, 13 were males, 46 females. Typically, the tumor is located between the rectum and the lower segments of the vertebral column. It may be deeply buried and project slightly, if at all, beyond the surface of the body, but the occult variety is quite infrequent. The existence of a deformity was obvious upon external examination at birth in 65 of the 72 cases recorded since 1924. In any event it becomes imperative to learn as far as possible by rectal touch to what extent the growth has penetrated in the direction of the pelvic cavity. It is generally found, however, that the neoplasm has followed the path of least resistance, outwardly, to form a mass varying in size and shape in different cases, and lying free between the lower extremities of the child. The area of external attachment is limited to the region of the sacrum and coccyx. In some instances the anal orifice lies upon the anterior border of the tumor, just below its junction with the perineum. The mass may extend posteriorly, to right or left, displacing the gluteal muscles.

The cutaneous surface of the tumor, of variable thickness, becomes quite thin in certain spots to which fragments of bluish membrane often adhere. Hypertrichosis is observed frequently. The presence of fistular tracts, with or without drainage, is exceptional. On palpation it becomes clear that the mass consists of intermingled solid and fluid compartments.

PATHOLOGY

Exhaustive microscopic surveys of long series of sacrococcygeal teratomas by Nicholson in 1929 and more recently by Willis have detected tissues that corresponded with almost every organ of the body, representatives of the kidneys and gonads were not identified. Willis laid stress upon his

¹ Johns Hopkins Ho p. Bull. 1901 12 96-101.

² A detailed tabulation of the 46 cases collected from the literature since 1930 will be included in reprints of this report.



Fig. 1. Infant prior to operation

observation that derivatives of each germ layer are usually clumped together even though their arrangement be quite disorderly. He also remarked among the specimens at his disposal a progressive gradation from relatively simple neoplasms containing rather indefinite embryological anlage to other abnormalities affording good examples of ischiopagia. These architectural variations, the intricate histological pictures presented by the tumors, their location at a point where several forces act to mold the embryo, and still other pertinent facts have provided good excuse for the multiplicity of hypotheses advanced to explain the origin of sacrococcygeal teratomas. An elaborate account of these theories has been given by Rosedale.

DIAGNOSIS

It becomes a matter of practical importance to differentiate these tumors from spina bifida. For this purpose very simple tests are applied preliminarily. Communication with the spinal canal should be ruled out whenever the mass is incompressible and when squeezing it does not cause the anterior fontanelle to bulge. Again an impulse is transmitted to a spina bifida if the infant cries or coughs, whereas the impulse will fail of transmission in cases of sacrococcygeal teratomas. Roentgenological examination of course will assist in reaching a diagnosis especially when masses of bone appear in the structure. In one instance

the injection of lipiodol into the spinal canal was employed. Aspiration of cystic areas in the tumor has been practiced, and even more significant evidence of their contents becomes available when ever cysts rupture during the course of birth. Sebaceous material and hair always establishes the teratoid character of a growth. In a few instances the eventual demonstration of well defined bowel has warranted the interpretation of the tumor as a fetal inclusion. A similar conclusion was reached by Ballantyne¹ who observed: A female infant with a large tumor attached to the postanal region which when examined by the roentgen rays was found to contain a spinal column and ribs obviously this was not a tail but an attached twin or parasitic fetus.

RESULTS OF SURGICAL TREATMENT

Among the 72 cases analyzed for purposes of this report 14 infants were stillborn, 11 died within a few days of birth, 45 came sooner or later to operation and in 2 described sketchily the clinical details were omitted. Whenever the infant survives the deformity alone provides ample indication for surgical intervention. Even more urgent reasons for prompt excision relate occasion ally to the pressure of the tumor upon neighboring organs causing for example an obstruction of the bowel or hindrance to the passage of urine. And

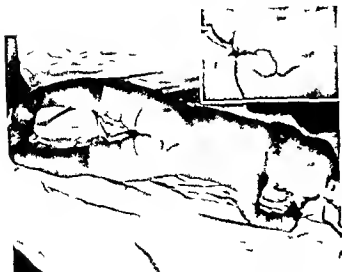


Fig 2 Infant following operation

significant indeed is the fact that malignant changes in the tumor were observed in nearly 9 per cent (6 instances) of the cases reported since 1924. The ages of 44 patients in the group reported since 1930 were a year or less in 28 cases, half of them being not over a month. Four operations were performed upon patients between the first and second years; 6 were between 4 and 18 years, and 6 between 20 and 60 years.

Complete excision of the tumor becomes a simple matter, if it is superficial, attached to its base by a slender pedicle. On the other hand, the technical difficulties which challenge the surgeon are more than ordinary whenever the growth extends into the pelvis, and satisfactory exposure requires removal of the coccyx as well as part of the sacrum. The steps in this procedure have been described admirably by Pearse. Tapping or partial removal of the tumor has proved to be ill advised, too often the sequel has been infection and a chronic fistular discharge. The therapeutic value of radiation has not been fully ascertained, but in all probability is limited to those cases in which evidence of malignancy has been found.

Of the patients who received surgical treatment since 1930, 57 per cent recovered (26 cases). In 8 other instances nothing was said of the end result. Eleven patients (24.4 per cent) died. With respect to the outcome of surgery at different periods of life recovery was announced in 64 per cent (9 cases) when the operation was performed during the first month of infancy, and in 57 per cent of 14 additional cases operated upon during the first year. Between the first and the eighth year 7 of 10 patients survived, whereas only 2 recoveries followed operation upon 6 patients between 20 and 60 years of age.



Fig 3 Roentgenogram of excised tumor

Upon statistical grounds, no less than for reasons fairly called humanitarian, the complete excision of sacrococcygeal teratomas should be undertaken at an early age, preferably during the period of infancy. Even if the tumor is small and at the time without any appearance of malignancy its excision should be recommended to eliminate a source of future discomfort and embarrassment.

REPORT OF CASE

A white female infant was seen in consultation with Drs R. D. McBurney and D. C. Shelby at the Cedars of Lebanon Hospital, February 22, 1935, 5½ hours after its birth.

The mother gave a history of a previous pregnancy ending in the birth of a normal infant. The pregnancy just concluded had also been normal and the labor with the fetus presenting by the vertex had advanced without complication until the head reached the perineum. A medio-lateral episiotomy failed in its purpose and Dr. McBurney used the obstetrical forceps to effect delivery. Then it became clear that the dystocia was due to a sizable tumor attached to the body of the infant. Its birth weight was 8 pounds. The placenta and membranes were normal.

The infant was a well developed female presenting a tumor mass in the sacrococcygeal region extending 2 inches dorsally from the posterior margin of the anus in the mid line and extending laterally 2 inches over either buttock. From this attachment the tumor expanded as an irregular nodular sac measuring 5 inches in diameter. The tumor was covered with normal skin except over the coccyx and in two other areas where the covering was a thin bluish membrane. Palpation demonstrated cystic and solid portions with irregular hard masses in the depths. There was no bulging of the fontanelles upon local pressure over the tumor. Rectal examination revealed that the tumor was superficial and a soft rubber catheter passed with ease into the rectum for a distance of 6 inches. There was no obstruction to micturition. X-ray examination demonstrated



Fig. 1. Infant prior to operation

observation that derivatives of each germ layer are usually clumped together even though their arrangement be quite disorderly. He also remarked among the specimens at his disposal a progressive gradation from relatively simple neoplasms containing rather indefinite embryological anlage to other abnormalities affording good examples of ischiopagia. These architectural variations, the intricate histological pictures presented by the tumors, their location at a point where several forces act to mold the embryo and still other pertinent facts have provided good excuse for the multiplicity of hypotheses advanced to explain the origin of sacrococcygeal teratomas. An elaborate account of these theories has been given by Rosedale.

DIAGNOSIS

It becomes a matter of practical importance to differentiate these tumors from spina bifida. For this purpose very simple tests are applied preliminarily. Communication with the spinal canal should be ruled out whenever the mass is incompressible and when squeezing it does not cause the anterior fontanelle to bulge. Again an impulse is transmitted to a spina bifida if the infant cries or coughs whereas the impulse will fail of transmission in cases of sacrococcygeal teratomas. Roentgenological examination of course will assist in reaching a diagnosis especially when masses of bone appear in the structure. In one instance

the injection of lipiodol into the spinal canal was employed. Aspiration of cystic areas in the tumor has been practiced and even more significant evidence of their contents becomes available whenever cysts rupture during the course of birth. Sebaceous material and hair always establishes the teratoid character of a growth. In a few instances the eventual demonstration of well defined bowel has warranted the interpretation of the tumor as a fetal inclusion. A similar conclusion was reached by Ballantyne¹ who observed: "A female infant with a large tumor attached to the postanal region which when examined by the roentgen rays was found to contain a spinal column and ribs obviously this was not a tail but an attached twin or parasitic fetus."

RESULTS OF SURGICAL TREATMENT

Among the 72 cases analyzed for purposes of this report 14 infants were stillborn, 15 died within a few days of birth, 45 came sooner or later to operation and in described sketchily the clinical details were omitted. Whenever the infant survives the deformity alone provides ample indication for surgical intervention. Even more urgent reasons for prompt excision relate occasionally to the pressure of the tumor upon neighboring organs causing for example an obstruction of the bowel or hindrance to the passage of urine. And

germ layers. The inner surface of the cystic cavity was lined with stratified squamous epithelium in conjunction with well developed hair follicles sweat glands and sebaceous glands.

Sections from the structure which grossly suggested a clitoris showed a lumen lined with epithelium similar to that of the esophagus. Tissues resembling cardiac and voluntary muscle were noted. Both cartilage and bone were present. In one place there were cavities lined with ciliated cylindrical epithelium with smooth muscle and plaques of cartilage so that the structure as a whole closely resembled a bronchus.

In one area the tissue was made up of small closely packed tubules lined with columnar epithelium however no glomerulus like structures were found. In addition these sections showed small islands of large cells with clear cytoplasm similar in appearance to the foam cells of the adrenal.

Representations of nervous tissue consisted for the most part of glial cells, but well developed nerve fibers also were identified.

Pathological examination confirmed the diagnosis of sacrococcygeal teratoma.

SUMMARY

Infants are not often born with sacrococcygeal teratomas and among those so afflicted stillbirth or death soon after the birth reduces substantially the number of cases which require clinical consideration. Differentiation of the tumor from spina bifida seldom offers difficulty. The deformity, of itself, always warrants surgical intervention even in the absence of complications, like visceral obstruction, and without references to the possible development of malignancy. Upon statistical grounds, no less than for humanitarian reasons, complete excision should be undertaken during early infancy, occasionally on the day of birth.

REFERENCES

1. ALLOT V. Ann ital di chir 1932 11 196
2. BRENNER M. Zentralbl f Gynaek 1932 59 1650
3. BRINES R. J Am M Ass 1934 103 338
4. BRITES C.olia anat Univ Conimb 1933 8 1-16
5. CALBET. Quoted by Brites loc cit
6. DELATRE A. J d sc méd de Lille 1933 51 125
7. FELS F. Monatsschr f Geburtsh u Gynaek 1932 92 97-80
8. FOCHER. Quoted by Brites loc cit
9. FORMICINI F. Arch di ostet e ginec 1932 19 284
10. FUGE K. Monatsschr f Geburtsh u Gynaek, 1935 99-100 317
11. HANSMANN G. and BERNE C. J. Arch Surg 1932, 25 1090
12. HEINE J. Frankfurt Ztschr f Path 1936 49 230
13. KEY W. Memphis M. J 1932 9 190
14. KUHLE W. Arch f klin Chir 1928 152 631
15. MEISTER W. Arch f path Anat 1933 288 286
16. MIRONE G. Ann ital di chir 1935 14 183
17. MORAN H. J. Cancer Research Comm Univ Syd ney 1935 6 144
18. MURESAN I. and DESLIU, G. Clujul med 1934 15 453
19. NICHOLSON G. J. Path & Bacteriol, 1929 32 363
20. NIEWIESCH, H. Deutsche Ztschr f Chir 1933 230 481
21. LEARSE H. Surg Gynec & Obst 1921 33 164
22. RENVER R. Am J Cancer, 1935, 24 617
23. REUSS A. Wien med Wchnschr 1927, 77 1208
24. ROLANDO F. La Pediatría 1931, 39 1298
25. ROSEDALE R. Am J Path 1935 11 323
26. SEGERS W. Beitr z path Anat u z allg Path 1933 93 401
27. SPITZER W. Zentralbl f Gynaek, 1932 56 1403
28. STRAETMANS R. Bruxelles méd, 1935 10 527
29. SZENDI B. Orvosi hetil 1933 77 824
30. TENCONI C. Riv di ostet (etc) 1933 15 547
31. TRAVAGLINI V. Ann ital di chir 1931 10 469
32. TRINCIERA C. Riforma med 1931, 47 991
33. WILLIS R. A. M. J. Australia, 1936 1 231
34. ZAMPA G. Arch ital di chir 1931 29 593

THE CONSERVATIVE TREATMENT OF DIABETIC GANGRENE

SAUL S. SAMUELS M.D., New York, New York

ONE of the most difficult problems in the treatment of diabetic gangrene has been the control of spreading infection of the foot and leg. Incision and drainage of infected areas with the application of wet dressings of boric acid or other standard solutions have been the accepted procedures heretofore but with disappointing results in the majority of instances. Time after time high amputation of an extremity in a diabetic patient is performed because of uncontrollable infection even in cases with fairly adequate circulation and a minimum amount of gangrene. Every surgeon is familiar with this situation.

Increasing experience with a new and remarkably efficient chlorine antiseptic azochloramid (1:3:4) has given results apparently unobtainable heretofore by orthodox methods in the control of diabetic infections. The following points must be emphasized as essential to success by this method.

1. Every area of so called dry gangrene in a diabetic extremity is a potential source of fatal infection.

2. Areas of established infection with pus formation must be immediately and adequately incised and laid wide open.

The terms dry and wet gangrene are so indefinite and smack so much of the medieval humors that they should be discarded from the scientific nomenclature of the vascular diseases. A gangrenous area, whether it be a toe or part of a foot, may be mummified so completely as to create the false impression that it is sterile. Cultures of these areas, however, particularly of the region of the line of demarcation, will reveal the presence of saprophytic organisms. When to this is added the contamination of bedding, flutes, etc., when such extremities are treated by exposure under a heated cradle, the possibilities of infection are increased enormously. To minimize the chances of secondary infection in a so called

dry gangrenous area it is advisable to apply a dressing of gauze saturated with 1:500 azochloramid in triacetin in such a way that the gangrenous portion and the adjacent healthy parts are

thoroughly covered. Over this a protective dressing of dry gauze is applied followed by a suitable bandage. Dressings may be changed every other day. It is important that careful technique be employed while changing dressings. Handling the gangrene or other parts of the foot with uncovered fingers is dangerous; sterile gloves or instruments are obligatory. Contact with blankets, moreover, is to be avoided particularly because of the possibility of gas bacillus infection from this source.

After the line of demarcation has been established careful separation of the gangrenous parts may be attempted with a sharp pointed scissors as much as possible on the gangrenous side of the line. Several sessions without anesthesia may be necessary to effect complete severance. After each manipulation it is very important that the opened areas be thoroughly packed with gauze saturated with a 1:500 solution of azochloramid in triacetin. If for instance a toe has been removed by this method, the stump must be completely covered paying particular attention to the region of the cut flexor and extensor tendons. Before the use of azochloramid these cut tendons were the danger points in the conservative treatment of diabetic gangrene. It was almost a foregone conclusion that as soon as the tendons, particularly of the plantar surface, were cut in removing a gangrenous toe, immediate retraction of the proximal end into the tendon sheath would carry infection into the deep plantar tissues resulting in ultimate amputation of the leg. However, with careful application of azochloramid packing to the stump of the toe, making sure that the gauze is forced into the tendon sheath, the possibility of spreading infection is greatly lessened.

After removal of the gangrenous toe the stump is dressed daily by first irrigating with Dakin's solution or a 1:3300 solution of azochloramid in saline or a 0.5 per cent chloramine solution. The usual packing with 1:500 azochloramid in triacetin is then applied followed by a protective dry dressing. This routine is continued until all slough is removed and the stump is filled with healthy granulations. When all signs of infection and slough have disappeared the granulating stump



Fig 1 left Case 1 Aged 60 years Infection originating in corn at base of small toe spreading along transverse fold at base of toes causing secondary gangrene of second toe Complete healing with spontaneous separation of gangrene Oscillometric index at right ankle 90

Fig 2 Case 2 Aged 40 years Diabetic infection originating in callus on sole of foot spreading to middle toe and up on dorsum of foot causing secondary gangrene of toe Completely healed Oscillometric index at right ankle 70

may be dressed with a bland ointment such as boric acid until complete healing has occurred

SITES OF INFECTION

Diabetic gangrene with established infection requires careful observation and knowledge of the usual routes of spread of the infectious process in the foot. The most common points of origin of infection in diabetic feet are (1) an interdigital fissure due to epidermophytosis, (2) a corn on the dorsum of the toes particularly the small toe, (3) a callus on the plantar surface of the foot, and (4) secondarily infected blebs or gangrenous areas following burns produced by baking lamps or heating pads.

Infection originating in an interdigital space may spread up on the dorsum of the foot usually for a distance of about 1 to 3 inches. This is a very common location for diabetic infection and one of the easiest to control because of the comparatively simple arrangement of tendons in this location. Careful palpation will usually elicit the site of pus collection which must be opened immediately and widely, and the resulting cavity thoroughly washed out with boric acid or Dakin's solution. Local infiltration or freezing anesthesia should never be attempted in this type of patient because of the danger of devitalizing the tissues. Gas anesthesia is sufficient or in most cases one quick cut can be made with a sharp straight scissors without the use of any



Fig 3 above left Case 3 Aged 57 years Severe gas forming infection arising in second interdigital space spreading to dorsum of foot with secondary gangrene of toe Infection spread further into deep plantar tissues requiring extensive incisions and packing with azochloramid Oscillometric index at right ankle 120

Fig 4 above center Case 3 Infection spreading along transverse fold at base of toes

Fig 5 above right Case 3 Complete healing with amputation of gangrenous second toe

Fig 6 below Case 3 Complete healing of dorsal infection

anesthesia whatsoever. The cavity is then packed thoroughly and tightly as for a hemorrhage with plain packing saturated with azochloramid or triacetin. A dry dressing is applied and the foot redressed every day. If in addition to the local ized pus infection there is a lymphangitis extending up the leg, it usually will be found that upon proper incision and packing as here described the lymphangitis will subside after 24 to 48 hours.

The next most common path of infection in diabetic gangrene is from the base of any of the toes along the flexor tendon sheath into the deep plantar tissues. If the infection originates at the base of any of the 4 small toes of the foot, it usually tracks its way to the neighborhood of the big toe. Such an infection can be diagnosed easily by careful pressure along various parts of the sole of the foot, at the same time it should be noted whether or not pus can be expressed from any opening that may be present. Expression of pus from the base of any toe by pressure at a distant point indicates a purulent pocket con-



Fig 7 left Case 4 Aged 56 years Diabetic infection originating in first interdigital space with secondary gangrene of second toe Infection spread to dorsum of foot Oscillometric index at left ankle 30

Fig 8 left center Case 4 Spread of infection along transverse plantar fold

Fig 9 center Case 5 Progress of healing

Fig 10 right Case 5 Completely healed

nected with the opening and situated at the point of pressure. A grooved director must be inserted along the infection tract until its point can be felt beneath the skin in the deeper tissues. In some instances a tract 3 to 4 inches long and about an inch deep may thus be explored. The grooved director is left in position and one blade of a sharp pointed straight scissors is inserted from the original opening to the depth of the grooved director. As a rule no anesthesia is necessary. With one quick cut the entire tract is laid wide open down to its furthest depths. If there are 2 or 3 side tracts connected with the main channel these must be slit open in the same manner. The pus is washed out and the tract packed widely and thoroughly with particular care that no dead spaces are present. Plain packing saturated with azochloramid in triacetin is used.

A third path of infection in diabetic gangrene is a transverse route across the base of the toes on the plantar surface. This must be incised with a straight scissors transversely and care should be used to make sure that every small adjoining pocket is thoroughly evacuated. Again irrigation and packing are carried out. These 3 locations: dorsum of the foot, deep plantar tendons and the transverse fold along the base of the toes are the 3 most common routes of infection in diabetic gangrene of the feet. The 3 incisions described will be found to be adequate for any of these types of infection.

For a few days after the incision has been made daily dressings consisting of irrigation with boric acid or Dakin's solution followed by thorough packing with azochloramid gauze are carried out. Particular care must be paid to careful palpation of tissues adjacent to the lines of previous incision to detect new pockets of pus.

If such are found they are to be split open immediately irrigated and packed in the usual way. After a week or 10 days it usually will be noted that there are no new extensions of infection. If such is the case dressings may now be changed every other day. At no time should wet dressings be used. If the patient's temperature is normal or below 100 it is best to carry on treatment with the patient in a wheel chair rather than in bed. The affected extremity however must be kept in the horizontal position at all times. It will be found usually that with adequate incision of infected areas the diabetes comes under control more easily and the need for insulin drops considerably.

Meticulous attention to all details is essential when these cases are dressed. After a few weeks gangrenous areas and sloughing tendons may be easily separated and removed. At about this time healing granulations begin to appear in the depths of the incision. Quite often a large piece of sloughing tendon will cause considerable purulent excretion in the depths of the wound. This is not to be confused with the formation of a new pus pocket. If such a sloughing tendon is found it should be gently removed provided it is thoroughly macerated. The same routine of irrigation and firm packing is continued until all slough and gangrene have been removed and granulations have completely filled the incised area. Epithelization follows rapidly thereafter.

Success with this type of case is dependent to a great degree upon the status of the collateral circulation in the extremity since the underlying vascular change is due to arteriosclerosis obliterans. For determination of this point an oscillometer is indispensable and yields information that can be gained in no other way. In 1929 Silbert and I observed that an oscillometric read



Fig 11 left above Case 6 Aged 66 years Diabetic infection arising in plantar callus tendon sheaths laid wide open Oscillometric index at right ankle 4.0

Fig 12 left center Case 6 Partial healing with secondary gangrene of second toe

Fig 13 left below Case 6 Extension of infection to dorsum of foot

Fig 14 right Case 6 Completely healed

ing of zero at the ankle usually indicates a bad prognosis in gangrene due to thrombo angitis obliterans. A reading of 0.5 or more at the ankle on the other hand is usually indicative of a fairly good collateral circulation. This observation may be utilized in diabetic gangrene in about the same manner, namely, an oscillometric reading of zero at the ankle in diabetic gangrene with infection indicates very little chance for successful conservative therapy. However, a reading of 0.5 or more at this level means that conservative control of the infection even in the presence of gangrene should be tried along the lines indicated above.

It is a strange fact that in many instances even with a good oscillometric reading an infection originating in a callus, corn, or interdigital space may produce secondary gangrene of one or more toes after a period of a week or 10 days. This may occur in diabetics in their early 30's, who without infection probably would not develop gangrene



Fig 15 Case 7 Aged 48 years Uncontrollable infection and gangrene Oscillometric index 0 Amputation above the knee Primary union

at all. This type of gangrene, secondary to infection in extremities with good oscillometric readings, is of a benign type and should not cause undue alarm. The extremity with a zero oscillometric reading at the ankle and primary gangrene complicated by a secondary infection presents quite a different problem. Although conservative therapy may be tried here with the same technique, it is usually unsuccessful because of the rapid spread of gangrene to important weight bearing portions of the foot with no tendency or indication of healing or granulation. Such a "zero" foot requires amputation through the lower part of the thigh according to the technique described elsewhere.⁽²⁾ The extremity with an oscillometric reading at the ankle of 0.5 or more with either infection or gangrene or both to such extent that the weight bearing portion of the foot appears to be completely destroyed may also require amputation, but of a different type.

For this form of diabetic gangrene the following operative technique has proved successful in my hands. A circular incision is made about 8 inches below the lower border of the patella through skin and soft tissues down to the tibia and fibula. The incision is extended proximally for about 3 inches down to the lateral surface of the fibula, the muscle planes being separated gently until the bone is reached. With a Gigli saw the fibula is removed at the upper and lower limits of the longitudinal incision. The operative field is now similar to that encountered in operations above the knee. The soft tissues are gently retracted proximally and the tibia is sawed through about 2 inches proximal to the level of the circular skin incision. By this technique the fibula is removed about 1 inch higher than the tibia. The sharp anterior ridge of the tibia is beveled off with

either a saw or bone forceps. The muscles are sewed over the end of the tibia and are fastened to the fascia anteriorly. The incisions are sewed with careful approximation of skin edges. To avoid reactions in the tissues silk instead of catgut is used throughout both for ligatures and sutures.

As a rule the patient may be out of bed a day after the operation in a wheel chair. Sutures may be removed on the fifth or sixth day and the patient sent home in 8 to 10 days. No tourniquet is used and cyclopropane anesthesia is preferred. With an oscillometric reading of 0.5 at the ankle and with careful technique primary union should be obtained routinely.

SUMMARY

In the diabetic patient gangrene differs from thrombo angitis obliterans in that infection plays a very great rôle.

Infection in diabetic gangrene heretofore an almost certain indication for amputation can be satisfactorily controlled with the use of a new chlorine antiseptic azochloramid.

An oscillometric reading of 0.5 or more at the ankle level indicates a favorable chance for success of conservative therapy. If amputation is necessary in this type of case it may be performed below the knee with excellent results by a new and simpler technique.

In the zero case amputation if required must be done through the lower third of the thigh silk is used for ligatures and suture, and the stump is closed without drainage.

BIBLIOGRAPHY

1. Council on Pharmacy and Chemistry. *J Am Med Ass* 1935 105 200.
2. SAMUELS S S. *The Diagnosis and Treatment of Diseases of the Peripheral Arteries*. New York and London Oxford University Press 1936.
3. SCHIMMELFUS F C and HORNING E S. Bactericidal action of azochloramid (N,N-dichloroazodicarbonamid) *J Bacteriol* 1935 29 No 3.
4. SCHIMMELFUS F C and MARAS H C. N,N-dichloroazodicarbonamid (azochloramid) an N-chloro derivative of the oxidant in an oxidation reduction system. *J Am Chem Soc* 1934 56 1610.
5. SILBERT S and SAMUELS S S. Thrombo-angitis obliterans (Buerger) prognostic value of the oscillometer. *J Am Med Ass* 1928 90 831.

REPAIR OF LARGE DEFECTS AFTER REMOVAL OF CANCER OF THE LIPS

ERNEST M. DALAND, M.D. F.A.C.S., Boston, Massachusetts

SMALL carcinomas of the lip may be excised by the classical V incision without deforming the lip (Fig. 1). The larger the lesion, the wider must be the V and the lower the apex of the V. This operation is not satisfactory for lesions over 2 centimeters in diameter, for it makes the lip so narrow that the performance of secondary procedures may be necessary.

A method for total restoration of the lower lip by using flaps from the nasolabial folds has already been described by the writer.¹ This operation gives a satisfactory result from the cosmetic standpoint. However, the new lip is devoid of muscle and serves only as a dam for food and saliva.

The problem discussed in this paper is that of reconstruction of the lip when from one third to two thirds has been removed. The operation often described consists in making lateral incisions from the commissures and parallel incisions from the lower edge of the defect outward and in moving a skin and muscle flap directly inward. This gives a tight and awkward lower lip and a redundant and overhanging upper lip, because the orbicularis has been divided on each side and its function has been destroyed.

The orbicularis oris is a muscle or group of muscles which encircles the mouth, passing from one lip to the other (Fig. 2). Fibers of other muscles of the face, anchored on the upper and lower jaws, pass into and help make up the orbicularis oris. Practically it may be considered as a circular muscle suspended by muscular fibers. The muscles on either side of the mouth exert sufficient pull to make the mouth a horizontal slit, the commissures being the ends of the slit. It is important to realize that the union of the mucous membrane with the skin is the same on all portions of the upper and lower lips and is no different at the commissures. Because of these facts the position of the commissures may be changed at will by altering the muscle pull.

We have not been satisfied with any operation that interfered with the function of this muscle and that left not only a useless segment of muscle in the upper lip, but also fragments of functionless muscles in the lower lip. Such a result is similar to that seen in the rectal sphincter when multiple incisions have been made. It occurred to us that the orbicularis oris and the commissures could be rotated. Would not a small mouth with normal musculature be better than a large mouth with no function of the lip? While we were contemplating the possibilities, a man with a particularly large mouth and with a wide, superficial low grade carcinoma consulted us and the operation about to be described was performed. The result was very satisfactory and we have now used this method in 23 cases. It is equally satisfactory in either the upper or lower lip.

TECHNIQUE OF OPERATION

The lesion on the lip is excised with a wide margin (1 cm.) of normal tissue (Fig. 3). The incision is made rectangular in shape and extends down to the fold between the lip and the chin. The corresponding mucous membrane is also removed, but it is not necessary to remove so much as is removed from the skin. The mucous membrane is separated from the muscle and skin for a distance of about 2 inches out on the cheek. (In dissecting up a mucous membrane flap it is always desirable to save as much fat on the mucous membrane as possible to insure a good blood supply.)

Incisions are made for a distance of 2 to 3 centimeters laterally from the lowest part of the defect. These incisions lie just below the orbicularis oris. Curved scissors are inserted in the wound and with the scissors curved with the muscle, any fibers from the adjacent muscles are divided up to about one half inch above the level of the commissure. Bleeding is checked by a temporary pack, but care must be used not to divide the facial artery.

It is now possible to close the defect. Since we have separated the mucous membrane from the muscle, we can now exert a medial pull on the mucous membrane and a rotary pull on the muscle and skin. The mucous membrane is sutured from the gingival margin to the vermillion border with

From the Plastic and Tumor Clinics, Massachusetts General Hospital, Longville Hospital and Westfield Sanatorium (Cancer Section) (Massachusetts Department of Public Health) and the Collis P. Huntington Memorial Hospital.

¹Daland, Ernest M. Plastic reconstruction of the lower lip. New England J. Med. 1931; 205: No. 24, December 10.

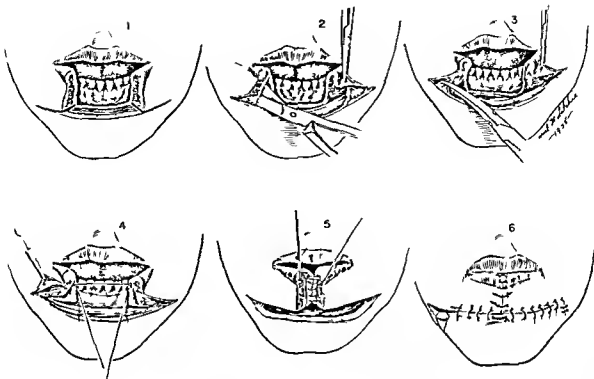


Fig. 3 Technique of operation for closing large defect in lower lip. 1 the carcinoma of the lower lip has been excised leaving a rectangular defect. 2 lateral incisions are made from the lower border of the defect. 3 the mucous membrane is separated from the skin and muscle. 4 the digital

tions of the peripheral muscles to the orbicularis oris are divided. 5 closure of the mucous membrane. 6 closure of the muscle and skin. 7 complete closure of the wound. A small triangle of tissue has been removed from the lower incision.

operable glandular metastases at the time of operation and died within a year. The other is a very recent case and the fourth attempt at closure was successful.

Of 14 lower lip cases available for study, one died of neck metastases 1 year after operation. This patient had had a bilateral upper neck dissection with positive glands. Two patients had local recurrences, one in the jaw and one in the lip. Both are free from disease the first $2\frac{1}{2}$ years after resection of the jaw and the second 4 months after x-ray treatment of the recurrence. All of the others are free from disease for periods from a few months to 4 years (Table I). Obviously this method of treatment of such large lesions cannot be considered a failure.

Function in the 6 upper lip cases was satisfactory except in the heavily irradiated case which was a failure. The upper lip alone was involved in two instances (Table II). One is well, the other patient had one small recurrence $2\frac{1}{2}$ years following treatment but is now apparently well. The original lesion here was very extensive and tem-

porary palpation was all that was expected and the result is gratifying.

Twice this operation has been done in connection with the removal of extensive cancers involving the upper lip, nose, jaw and cheek. There has been no recurrence in the lip in either case, although one patient had further trouble in the jaw but this was successfully treated by irradiation. The other is entirely free from disease 4 years later.

One patient had extensive disease of the nose and face as well as of the lip. He had a rapid recurrence which did not respond to treatment and he is probably dead. The last case was the patient with cancer of the upper lip and commissure with metastases in the neck from which he succumbed. Cure was not expected.

This group is too small to give us definite conclusions. With only the lip involved the results are satisfactory. When other structures are involved the results are only fair. However as a part of extensive plastic procedures in rebuilding the face the method has a place.

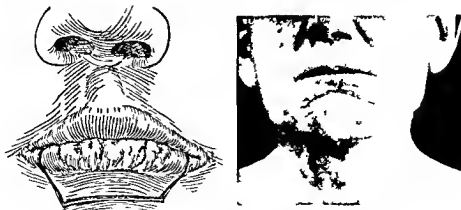


Fig 4 Case 1 a left Drawing made at time of operation Note that about three fifths of the lip is involved and that about four fifths has been marked for removal b appearance 3 weeks after operation



Fig 5 Same case as in Figure 4 front and lateral views Note shape and size of mouth

CASE 1 L W Baker Memorial 11750 admitted to hospital November 1 1933 Two years previously he had developed a nodular area in the center of the lower lip One physician advised against any treatment but later another physician had done a biopsy and found malignancy During these 2 years there had been a steady increase in size

On examination the middle one half of the lower lip was found to be involved by an ulcerated indurated new growth 2 by 2.5 centimeters in size The growth lay entirely on the mucous membrane and did not involve the vermillion border One hard node was felt in the right submaxillary triangle

Operation was done under general anesthesia and consisted of a bilateral upper neck dissection from one sterno mastoid muscle to the other and a resection of the central three fourths of the lower lip with closure by the method described Following operation the temperature of the patient remained elevated to 101 degrees for 4 days then became normal He had a severe cough with much sputum Eleven days later his temperature rose to 105.5 degrees and a lung abscess was suspected However the fever subsided rapidly and there were no further lung complications The final diagnosis was probable pulmonary infarction He was discharged 20 days after operation He was able to eat well and could also whistle suggesting an intact musculature of his lip Microscopically this lip lesion was an epidermoid carcinoma with no glandular involvement

When he was last seen in December 1937 more than 4 years after operation the cosmetic appearance was excellent and the scars were scarcely visible There has been no recurrence (Figs 4 and 5)

CASE 2 D R Massachusetts General Hospital 305664 aged 62 years was admitted to hospital in March 1930 A lesion 1.5 by 1.5 centimeters on the left side of the lip was excised and the left submaxillary region was dissected The lip lesion was a grade 2 epidermoid carcinoma and the glands were negative One year later a second carcinoma grade 1 was excised from the right side of the lip

On December 26 1935 the man appeared with a recurrence on the left side adjacent to the old scar and extending to the commissure An excision of about three fourths of the remaining lip was done with the usual type of plastic closure Right side of neck dissected 1 week later Pathological reports showed lip grade 3 epidermoid carcinoma neck glands negative Recovery satisfactory except for slight separation of wound with a resulting notch

He was well until February 1938 when he showed a recurrence 2 by 1 centimeter This was apparently due to impingement of one solitary upper tooth on his tight lower lip After the tooth was removed the recurrence disappeared under x ray therapy (Fig 6)

CASE 3 I McG Massachusetts General Hospital 350012 aged 63 years was admitted to hospital on December 4 1935 Examination revealed a carcinoma of the center and left side of the lower lip 2 by 1 centimeter of 6 months duration with no palpable nodes Excision of the lesion was done with the usual closure by plastic taking the flap from one side only One week later a left upper neck dissection was done The pathological report was grade 2 carcinoma of lip glands negative On January 31 1938 he was free from recurrence (Fig 8)

CASE 4 M V Massachusetts General Hospital 330243 aged 63 years was admitted to hospital June 30 1933 He



Fig. 6 Case 2 a left Carcinoma of the upper lip before operation b result 4 months later Patient has been free from disease for over 4 years

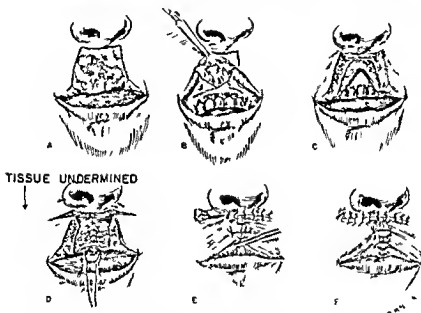


Fig. 7 Carcinoma of the upper lip The same technique has been carried out as in the operation for carcinoma of the lower lip

had a lesion on his lower lip which had been present 17 years and for which he had received three radium treatments without benefit. The middle half of the lower lip was involved in an outcropping new growth 4 by 5 centimeters. In the left submaxillary region a firm node 1 by 1 centimeter was palpable.

On July 1, 1931 the middle two thirds of the lip was excised and the defect was closed by rotating the orbicularis muscle with the skin. Ten days later a bilateral upper neck dissection was done. The pathological examination was grade 2 epidermoid carcinoma of the lip with no carcinoma in the neck. The lip wound separated entirely after the second operation presumably due to ligation of part of the blood supply and a secondary suture was done.

He was not seen again until September 2, 1936 (3 yrs. 2 months after operation) when he returned with a tiny fistula in the old scar which had been present since the first operation. There was no recurrence in the lip or neck. The fistula was successfully closed (Fig. 9).

CASE 5 W. R. Pondville Hospital 11641 aged 46 years was admitted to hospital November 7, 1936. The outer third of the lower lip was involved in a hard nodular growth while the middle third showed more superficial indurated areas. A hard node 1 by 1 by 1 centimeter of 4 months duration was felt in the left submaxillary region.

On November 9 a left upper neck dissection was done and the involved portion of the lip was removed. The defect was closed in the usual manner. Pathologically the growth was a grade 2 epidermoid carcinoma and the glands showed only hyperplasia. No dissection is contemplated for the other side.

In February 1938 there was no recurrence in the lip or neck. The cosmetic result was satisfactory although the lower lip was still somewhat tight.

CASE 6 P. C. Pondville Hospital 11614 aged 64 years was admitted to hospital January 7, 1937. Examination showed a papillary carcinoma 1.2 centimeters in diameter in the left central portion of the lip with small movable nodes



Fig 8 Case 3 a left Carcinoma of lower lip involving nearly one half the lip b result after operation In one the plastic operation has been done on one side only Note the new commissure Patient free from disease over 2 years



Fig 9 Case 4 a left Carcinoma of lower lip before operation b result 3 years later A persistent sinus has just been closed The lymph nodes in both sides of the neck were negative

in each submaxillary region. A rectangular area was excised and a plastic was done on January 18. Eleven days later a left upper neck dissection was done. Pathological examination showed a grade 1 epidermoid carcinoma of the lip with hyperplasia of the lymph nodes.

This is one of the more recent cases in the series. The immediate postoperative result is satisfactory. There was no recurrence up to October 1937.

CASE 7 J. D. Pondville Hospital 8805, aged 78 years was admitted to hospital December 9, 1934. He had an extensive carcinoma of the lower lip of 2 years' duration. Previous treatment had consisted of desiccation and radium seeds at another institution. A large radiation ulcer with active growth was present but no lymph nodes were palpable.

A section of the lower lip measuring 3 by 2 centimeters was excised and the defect was closed by the usual technique. Pathological examination revealed epidermoid carcinoma grade 1, with radiation reaction. No neck dissection was done.

He died on January 25, 1936 of pneumonia. There had been no recurrence of the lip lesion.

CASE 8 J. C. Pondville Hospital 7650, aged 65 years was admitted to hospital April 7, 1934. Examination showed a carcinoma of the central two thirds of the lower lip of 3 months' duration. The patient had had no previous treatment. The Wassermann test was positive. His teeth were very bad. There were no palpable lymph nodes in the

neck. His general condition was poor in that he was just recovering from an operation for a perforated duodenal ulcer.

Several days were consumed in extracting teeth and cleaning up his mouth. Operation was done under novocain. A segment of lip measuring 5 by 2.5 centimeters was removed. Healing occurred promptly in spite of a very tight wound closure. The pathological report was epidermoid carcinoma grade 1. No neck dissection was done but it was our intention to do it if nodes appeared.

In June 1937 his local clinic reported that there was no recurrence.

CASE 9 V. D. Pondville Hospital 5969, aged 56 years was admitted to hospital March 28, 1933. A V excision was done for a small lesion on the lower lip reported as epidermoid carcinoma grade 2. The patient refused neck dissection. Deep x-ray therapy (2400 r units) was given to the left neck.

Three years later he returned with a new lesion immediately adjacent to the old scar, size 2.5 by 2.5 centimeters. A firm node was palpable in the left submaxillary region.

A bilateral neck dissection and a wide excision of the lip lesion with plastic closure were done at one sitting. There was some separation of the lip wound during the next few days with sepsis in the right side of the lip. The pathological report showed a grade 1 lesion on the lip with no involvement of the neck nodes.



Fig 10. Case 9. a left Carcinoma of lower lip before operation b result 3 months later. Patient well 43½ years.



Fig 11. Case 14. a left Carcinoma of lower lip before operation b result 2 weeks after operation. Patient well 43½ years.

He was examined in his local clinic in January, 1937 and found to be free of disease. A dental worker made the same report October 22, 1937.

Note—It was a mistake to do the lip and the neck operations at the same sitting (Fig 10).

CASE 10. W. C. Landonville Hospital 8237, aged 73 years came to the outpatient department August 2, 1934 for a large about an olive sized lesion on the lower lip. Wide excision was advised and the man was sent back to his own hospital where the lesion had previously been treated by x-ray. At that hospital the lesion was treated by electrocoagulation. He returned to us 3 months later with a large defect in his lip with apparently active new growth but no palpable lymph nodes. He was drooling constantly.

Wide excision with plastic closure was done on November 5, 1934. Three months later a skin graft was placed inside the lower lip to provide a sulcus between the lip and jaw. Tissue removed at these two operations showed no cancer.

Three months later he appeared with a recurrence at the base of his lip and also involvement of the jaw. Resection of the lower jaw was done by Dr. C. W. Taylor. Later several plastic operations were done by Dr. Taylor to restore his lip and buccal mucosa. Both sides of the neck were dissected at separate sittings and large metastatic carcinomas were found in the nodes.

In June 1938 there was no evidence of recurrence. Patient had no complaints except for some drooling of saliva. He had been able to maintain his weight fairly well.

CASE 11. J. K. Landonville Hospital 9781, aged 74 years was admitted to hospital August 27, 1935. Examination

showed a carcinoma measuring 2.5 by 2.5 centimeters on the right side of the lip with a smaller lesion .05 by .05 centimeter at the left of the midline. There were no palpable nodes in the submaxillary areas but there was a small one in the submental triangle. He had previously received several x-ray treatments without benefit.

He also had a hard tumor mass in the right inguinal region extending into the right lower abdominal quadrant. There was a marked induration of the epididymis with thickening along the vas deferens. There was a scar along the iliac crest from an operation 15 years before. The details of which were not known. This mass was apparently not primary in the genito-urinary or gastro intestinal tracts and its exact nature was unknown.

Operation was done on September 2, 1935 under local anesthesia. About two thirds of the lip was removed. The lip healed without difficulty. The pathological report was epidermoid carcinoma, grade 2. One month later the wound was well healed. He died at home 2 months after operation apparently from his abdominal condition.

CASE 12. J. V. Pondville Hospital 8724, aged 67 years was admitted to hospital November 22, 1934. He had an ulcerated carcinoma involving the left half of the lower lip without palpable lymph nodes. He had previously had radium treatments and a submental dissection with temporary improvement in the lip lesion.

Several bad teeth were removed, the lesion was excised and a plastic was done. The specimen measured 3.5 by 2.5 by 2 centimeters. An pathological examination showed epidermoid carcinoma, grade 2. No neck dissection was done.



Fig 12 Case 15 a Carcinoma of lower lip before operation b result 1 week after operation c result 2 months after operation This patient had bilateral dissection of

the upper neck glands in both sides of the neck which were positive He died of a recurrence in the neck 1 year following operation

On February 4 1937 he was examined and was free from disease There were no palpable nodes

A Public Welfare report said he was all right in December 1937

CASE 13 J D Pondville Hospital 8185 aged 69 years was admitted to hospital July 28 1934 Examination showed carcinoma of 8 months duration involving the central half of the lower lip with ulceration and induration One small node was palpable in the right submaxillary triangle

The middle two thirds of the lower lip was removed under novocain the specimen measuring 3.5 by 2.5 centimeters Pathological examination revealed epidermoid carcinoma grade 2 The wound healed well and 2 weeks later a right upper neck dissection was done The nodes showed no cancer Dissection of the other side was advised but refused by the patient

He died June 4 1935 of coronary heart disease without recurrence of the cancer

CASE 14 J C Pondville Hospital 7698 aged 77 years was admitted to hospital April 5 1934 The lower lip was involved by an ulcerated destructive new growth There were no hard nodes in the neck

The middle two thirds of the lip was excised under novocain and the defect closed There was some sepsis in the wound and a fistula developed This healed rapidly however Pathological examination of a section of lip 4 by 2.5 centimeters showed epidermoid carcinoma grade 2

No dissection of the glands was done He was free of disease in September 1937 The cosmetic result was very good He was edentulous but wished to have teeth fitted if possible (Fig 11)

CASE 15 A S Pondville Hospital 9503 aged 54 years was admitted to hospital June 15 1935 The left half of the lower lip showed a proliferating ulcerated carcinoma from the commissure to the midline This had been present for 18 months and he had noticed a lump in the neck for 4 months He had hard movable nodes in the submental space and a hard slightly fixed node in the left submaxillary area His teeth were very bad and these were all extracted before his lip was operated on The Wassermann reaction was positive

A segment of lip 5 by 3 centimeters was removed under novocain and the wound was closed by a plastic operation The pathological report was epidermoid carcinoma grade 2

One week later a right upper neck dissection was done under ether He behaved badly under ether and the second

side was not dissected but later this was done under novocain Microscopically the nodes in both sides of the neck showed grade 2 epidermoid carcinoma His lip and neck wounds healed well His mouth aperture was very small

Eleven months later he returned with a massive recurrence along the left sternomastoid muscle down to the clavicle He received x ray therapy (1200 r) to the left lateral neck on June 16 1936 The growth was very rapid and he died on July 8 1936 of bronchopneumonia Pathological examination at autopsy showed the same grade as previously and no metastases except in the neck There was no recurrence in the lip

Note—The operative note on the second neck dissection stated that a metastatic node was found along the internal jugular vein This should have been the deciding factor in doing a radical dissection on this side Had this been done the outcome might have been different (Fig 12)

CASE 16 H Westfield Sanatorium Cancer Section 45 aged 64 years entered sanatorium on January 6 1938 Examination revealed a fungating mass just to the left of the midline on the lower lip involving the mucous membrane and a small portion of the skin The mass was hard in consistency and measured about 2.5 centimeters in diameter His teeth were carious There was no evidence of glandular involvement On January 10 1938 the patient had complete extraction of twenty one teeth Nine days later at which time there was satisfactory healing of the gums excision of the carcinoma with plastic to the lower lip was done under local anesthesia Convalescence was satisfactory except for two minor stitch infections which subsequently healed satisfactorily and the patient was discharged on the fourteenth postoperative day The pathological report was epidermoid carcinoma of the lower lip grade 2 When the patient was seen in the outpatient department on July 20 1938 the wound was well healed and the angles of the mouth were symmetrical There were no palpable glands The patient was working and in good general health (Fig 13)

CASE 17 W R Massachusetts General Hospital 94888 aged 65 years was admitted to the Tumor Clinic in November 1937 He showed an indurated excavated lesion 2 by 1.5 centimeters in size on the right side of the lower lip There was an enlarged firm node under the angle of the jaw A biopsy was done but the specimen was unsatisfactory for diagnosis High voltage irradiation was given in three cycles from November to March One month after the last treatment it was felt that there was



Fig 13 Case 16 a Carcinoma of lower lip before operation b photograph of specimen showing the amount of

normal tissue removed with the tumor c result 2 months after operation

persistent disease present. He had a deep ulcer from which saliva constantly oozed. He was referred to the hospital for excision.

Excision was done on April 5, 1938, by a senior visiting surgeon and the patient was allowed to go home the following day. The stitches were removed 1 week later but the lower portion of the incision separated. The pathological report on the tissue removed was: acute and chronic inflammation. He was readmitted 3 weeks later and the defect, now completely separate, was closed. Again there was separation.

One month later a third attempt was made by the writer. The edges were excised and the type of plastic described as used. On the 18th day separation occurred. At the fourth operation the method used was a combination of the one used previously and the one referred to earlier in this article and it was successful. The node in the neck has disappeared.

Note—Any attempt at surgery in a lip as heavily irradiated as this one was ill advised and failure was inevitable.

CASE 9 W. M. Massachusetts General Hospital 330128, aged 42 years, was admitted to hospital in March, 1934. He presented an indurated ulcerated nodular tumor of the upper lip measuring 1.5 by 2 centimeters of but 6 weeks duration. A dark field examination was negative for prochetes. Biopsy showed a benign epithelioma. There were no palpable lymph nodes.

On March 28, 1934, the lesion was excised. Closure was by the same method described for the lower lip. This was the first time the operation had been used on the upper lip. Healing was uneventful. Pathological examination showed epidermoid carcinoma, grade 1.

He was last seen on June 29, 1938. His scars are scarcely visible and his mouth showed no appreciable narrowing. There were no palpable lymph nodes and there was no recurrence in the lower lip.

Note—No neck dissection was advised in this case. Inasmuch as this was a grade 1 carcinoma it was thought neck dissection was unnecessary unless nodes appeared.

CASE 10 J. H. Pondville Hospital 3643, aged 76 years, was admitted to the hospital August 21, 1931. Three years previously he had received radium treatment to a carcinoma of the buccal mucosa at a hospital in a nearby state. On admission to Pondville there was a large area of necrotic

carcinoma inside the right cheek involving the commissure with a large perforation in the cheek. There was also a hard fixed mass in the submaxillary region. Biopsy showed adenocarcinoma. Radium needles were used to destroy the lesions of the mouth and face and deep x-ray was used on the neck. The former cleared up entirely and the latter area showed marked improvement.

He returned in June, 1934, with no recurrence in the face or mouth but the glandular metastasis was active and more irradiation was given. His chief difficulty was from the defect caused by the destruction of his mouth cancer. Nearly half of the upper lip, together with an area at the commissure, was missing.

In September, 1934, the dense scar tissue was excised and the remainder of the upper lip was mobilized, and the defect was closed by uniting the edges of the orbicularis muscle and skin. The result at first was very satisfactory but a few days later the wound was separated and the defect was as bad as before.

In January, 1937, he was again a patient in the hospital with active disease in the neck, now giving him considerable pain. He was 81 and no further surgery was done. He died of cancer in the neck in June, 1937.

Note—This is one of 2 cases in the series in which total separation of the wound has taken place. Doubtless the irradiation was largely responsible for the failure.

CASE 20 J. W. Massachusetts General Hospital 350737, aged 63 years, was admitted to hospital December 30, 1935. Thirty years ago he received x-ray treatments to his nose and face for lupus vulgaris. For 1 year he had had an ulceration of his upper lip. Examination showed an ulcerated indurated lesion 2 by 3 centimeters on the upper lip extending onto the right cheek. There were no palpable lymph nodes.

Excision of the lesion was done on January 2, 1936, leaving a full thickness defect on the lip and a large defect on the cheek. The lip defect was closed by rotating the commissures and the muscles. The remainder of the defect was closed by a sliding flap from the cheek. The immediate result was satisfactory. The pathologist reported a grade 2 epidermoid carcinoma.

On June 25, 1936, he appeared with a 2 by 2 centimeter recurrence in the center of the upper lip. He received high voltage x-ray treatment (2100 r units) but he did not complete the treatment planned.

On August 10 1936 he was admitted to the Pondville Hospital (11275) still with active disease. He was given deep x ray (1800 r units) and discharged on August 25 1936. He has not been seen since, but a letter from his local clinic stated that his disease was very extensive and he has probably died.

CASE 21 M. C. Massachusetts General Hospital (Phil lips House) 32558 aged 42 years was first seen on November 7 1933. His lesion began on his eyelid 14 years ago and slowly advanced without treatment for 9 years. He was then seen by a surgeon who advised evisceration of the orbit but this was refused. Inasmuch as he was a Christian Scientist he never felt the need of medical care until admission.

Examination showed a large ulceration on the right side of the face with active indurated edges. The disease involved the right side of the nose about half of the upper lip the outer third of the lower lip the antrum orbit right frontal sinus zygoma malar bone and the tissues over the ascending ramus of the jaw. There were no palpable lymph nodes.

On November 14 1933 a very extensive electrosurgical excision and electrocoagulation was done following ligation of the external carotid artery. It was possible to encircle all the disease except one area on the posterior wall of the frontal sinus where there was erosion through to the dura. Following operation he received deep x ray treatment to the entire wound but particularly to the posterior wall of the frontal sinus. In March 1934 plastic operations were started. The following year reconstruction of the right side of the nose the upper lip lower lip and entire cheek was done until the only defect left was the orbit and the frontal sinus.

The operation described in this paper was used to reconstruct the upper lip and it was possible to rotate the lip so that hair bearing skin was used for the entire upper lip. This made it possible for the man to grow a mustache and to help cover the scars.

There has been no recurrence of his carcinoma in 4½ years. The reconstructed mouth has been very satisfactory.

CASE 22 S. M. Huntington Hospital 341089 aged 63 years was admitted to hospital on September 26 1934. Examination showed an extensive lesion of the left side of the nose at the ala involving the upper lip and extending through the hard palate into the mouth. It had also destroyed part of the nasal septum. The lesion had been present and increasing in size for 15 years. Biopsy showed basal cell carcinoma.

On September 26 1934 electrosurgical excision was done under avertin anesthesia. One inch of the upper lip the septum the turbinates on the left the left ala and a portion of the upper jaw were removed. Flaps were mobilized and the upper lip was reconstructed across the defect in the bone.

Later reconstruction of the nose was done from forehead

flaps. An upper denture was made to fill the defect in the upper jaw and to bring the upper lip gradually forward.

In March 1937 a recurrence appeared in the nose and on the upper jaw behind the defect. Electrocoagulation was done twice and high voltage x ray treatment was given. New carcinomas of the hand have been effectively treated. There has been no recurrence in the upper lip on which the plastic was done. It is doubtful if there will be a permanent cure in this case but the plastic procedure has had a part in giving him palliation. The patient was last seen on September 20 1938.

CASE 23 C. C. Massachusetts General Hospital 5255 aged 70 years was admitted to hospital first on September 8 1933. She gave a history of having had lupus vulgaris of the nose and lip 50 years before. A basal cell carcinoma of the upper lip was removed by another surgeon. In June 1934 a recurrence was removed by the writer. In November 1935 she returned with extensive involvement of the entire upper lip and of the tip of the nose which had already been badly damaged by the lupus.

A radical removal of the entire upper lip was done with reconstruction by the usual technique. The nasal lesion was also excised. Pathologically this was a basal cell carcinoma with foci of keratinization and with a few tubercles. Recovery was uneventful the function of the lip is satisfactory but the cosmetic appearance is far from good.

She remained well for nearly 2 years when a small ulcer appeared in the center of the scar. This did not respond to irradiation and was excised. It proved to be a grade 3 epidermoid carcinoma. The defect was closed by an immediate thick skin graft. She is now 75 and works regularly as a housekeeper. Five years ago it was considered doubtful if her heart would stand up under any operation.

SUMMARY

An operation is described for the reconstruction of either the upper or lower lips when any amount less than the total width of the lip has been removed. The advantage of this operation is that it leaves a completely intact musculature of the mouth. The only disadvantage is that the mouth is smaller than normal.

The cosmetic results in the patients operated on by this method have been satisfactory. The functional results have been good.

As a curative operation it appears to be adequate, although few of the patients have been followed more than 3 years.

Case histories of 23 patients upon whom the operation has been used are presented.

NON-TRAUMATIC PARALYSIS OF THE DORSAL INTEROSSEOUS NERVE

LAURENCE M. WEINBERGER, M.D., Philadelphia, Pennsylvania

HERE has accumulated in the literature a small number of cases of isolated paralysis of the dorsal interosseous nerve. Though this group is small it is an exceedingly interesting one not only on account of the curious clinical picture but also because there has been no satisfactory explanation of the causative factors.

The syndrome consists of the progressive paralysis and subsequent atrophy of the muscles innervated by the dorsal interosseous nerve. The onset may be gradual or fairly rapid and is manifested first in the typical case by the inability to extend the little finger. In time the fourth finger is affected in the same way and then relentlessly the third, second and index finger and finally the thumb. In the full-blown case the afflicted person is unable to extend any of the fingers or extend and abduct the thumb. Wasting of the bellies of the extensor muscles of the fingers eventually follows so that the dorsum of the forearm becomes atrophied. Reaction of degeneration to electrical stimulation occurs in these muscles. The extension of the wrist though impaired is relatively preserved owing to the fact that part of the extensor function of the wrist is carried out by muscles not innervated by the dorsal interosseous nerve. The paralysis has not been accompanied by any disturbances of the sensory innervation of the hand or arm. There have been no spontaneous recoveries or for that matter any produced by therapeutic measures.

Several speculations have been advanced to explain the syndrome. Woltman and Learmonth who published reports of cases proposed on the basis of their one case in which operation was carried out that the paralysis is caused by an anomaly in the course of the nerve. They admitted however that this hardly seemed a satisfactory explanation.

Guillain, Georges and Courtellemont suggested that the cause might lie in chronic trauma to the nerve produced by too frequent pronation and supination of the arm since the nerve passes through the substance of the supinator brevis muscle. Grigoresco and Iordanesco were of the

opinion that direct trauma to the nerve possibly accounted for the paralysis in their case. On analysis however none of these explanations serves to explain all of the clinical facts noted in these cases. The opportunity to study cases recently prompted a review of the 10 cases recorded in the literature and on the basis of this analysis to advance a tentative theory which though it requires future verification seems adequately to account for the entire clinical picture.

CASE 1. The patient was a 41 year old dairy farmer who was admitted to the neurosurgical service of Dr. Francis C. Crani complaining of inability to open his hand and of wasting of his forearm. His work consisted chiefly of milking 20 cows twice daily, a task that he had performed for 25 years. About 5 months before admission while cranking a tractor the crank bucked and threw him backward wrenching his arm. Immediately after and his forearm and wrist felt sore and he consulted a physician. He could find nothing wrong but took an x-ray picture which however was reported negative. He continued working and the soreness wore off. He noticed shortly after this incident that when he shook hands with friends he had difficulty in relinquishing his grasp. When he observed his trouble closely he found that it was due principally to inability to extend his fifth and fourth fingers. In the following 3 months the third, second and index fingers became weak and this interfered with his work. Toward the end of milking a cow the final stripping of the udder requires twisting of the hand necessitating a degree of ulnar deviation; this he found he was unable to do well. He gradually became aware that the back of his forearm appeared thinner. A month before admission the back lurch of an automobile crank again threw him and he experienced a tingling throughout the forearm for several hours. Subsequent to this second accident he found that after milking a while there was rapid fatigue of his arm and an unpleasant drawing sensation extending from his wrist to his elbow.

The general physical examination was essentially negative. He possessed an unusually powerful muscular development. The neurological findings were limited to the right arm and hand. There was inability to extend any of the fingers and to extend and abduct the thumb; the weakness was greatest in the fifth and fourth fingers (Fig. 1). The opposing function of the thumb was intact; flexor power of the fingers was normal and his grip was equal to that of the left. He was able to extend the wrist though weakly. The forearm was wasted over the dorsolateral aspect and this was emphasized by the compensatory hypertrophy of the brachioradialis and extensor carpi radialis longus muscles. Both these muscles derive their innervation from the radial nerve just above the origin of the dorsal interosseous nerve (Fig. 2). Radial deviation was possible though ulnar deviation was not. Just below the elbow in the region of the insertion of the radial head of the biceps tendon there was a point so tender to deep pressure that pressing upon it caused the patient to wince. The tender



Fig 1 There is paralysis of extension of the fingers and thumb of the right hand. The wrist is partly though in completely dorsiflexed. The fingers already show a mild degree of flexor contractures. Case 1



Fig 2 The two forearms are compared to demonstrate the marked atrophy of the bellies of the extensors of the fingers of the right arm. The contrasting hypertrophy of the brachioradialis and extensor carpi radialis longus muscles is clearly depicted. These latter receive their innervation from the radial above the origin of the dorsal interosseous nerve. Case 1

ness was sharply localized and there was no radiation of the pain. Electrical stimulation showed that the common extensor, the extensor carpi ulnaris and the extensors pollicis longus and brevis were inactive to stimulation carried up as high as 250 volts. Stimulation of the radial nerve directly with galvanic current failed to provoke movement in any of the muscles supplied by the dorsal interosseous nerve. The brachioradialis and the extensor carpi radialis longus reacted promptly.

Operation to explore the nerve was offered to the patient but he refused because no definite assurance of improvement could be given him.

CASE 2. The patient was a 32 year old woman admitted to the neurosurgical service of Dr Francis C Crant in May 1938 complaining of inability to open the fingers of her left hand. The patient had been a corsetiere for 5 years before the onset of her trouble. About 4 years before admission she began to notice that she could not open the last three fingers of her left hand. This was brought to her attention mainly through a feeling of weakness in these fingers noted when she attempted to pull down a corset. In performing corset fittings she pulled the lower edge of the corset forcibly down over the hips of the customer with her left hand and held it so while pinning with the right hand. She fitted from 12 to 15 corsets daily and stated that at the end of her working day her left arm and hand were always very tired. Occasionally during the day it cramped from the strain and she had to massage it.

In the 6 months following the onset of weakness of her last three fingers the weakness spread and involved her index finger and thumb so that she was unable to open any of her fingers. Since then there has been no change except that lately her fingers curl in toward the palm and are difficult to straighten out. In the past 3 years she has also been aware of a gradual wasting of her forearm. Massage and heat treatments have not helped her.

The general and neurological examinations were normal except for the condition of her left arm. There was a paralysis of extension of all the fingers of the left hand and a paralysis of abduction and extension of the thumb (Fig 3). The ulnar and median functions were all present and intact. The wrist could be weakly extended and the hand could be freely ulnar deviated but could not be radially deviated. There was a mild degree of contracture in the unopposed flexor tendons of the fingers. The bellies of the extensor muscles of the fingers were atrophied causing marked wasting of the forearm. The brachioradialis and extensor carpi radialis longus were again preserved but

in this patient not hypertrophied. The muscles innervated by the dorsal interosseous nerve were entirely unresponsive to electrogalvanic stimulation even when carried up to 250 volts. The brachioradialis and extensor carpi radialis longus reacted promptly to normal threshold stimulation. Sensation was examined minutely with graduated von Frey hairs and thorns but no sensory disturbances were found.

Approximately 2 inches below the bend of the elbow over the insertion of the radial head of the biceps tendon was a point exquisitely painful to deep pressure. The patient cried out when it was pressed upon. She had not been aware before that there was a tender spot. On deep pressure it was possible to feel a small nodule sliding under the fingers and this seemed to be the most tender site (Fig 4).

It was suggested to the patient that exploration of the nerve offered the only possibility of relief but since no assurance of cure could be offered the patient refused operation and left the hospital.

ANATOMICAL FEATURES

It appears that the solution of this syndrome may depend upon certain pathological processes and more especially upon certain anatomical features which heretofore have not received recognition in the published reports.

Briefly, the radial nerve terminates a few centimeters above the lateral condyle of the humerus by dividing into the dorsal interosseous nerve and the superficial radial cutaneous nerve. The dorsal interosseous nerve descends in the cleft between the brachialis and brachioradialis muscles, passes under the extensors carpi radialis longus and brevis, turns obliquely and pierces the supinator brevis muscle. It emerges at the lower border of the supinator and breaks up into two main branches one of which supplies the common extensor, extensor carpi ulnaris, and the extensor digiti quinti proprius. The other innervates the abductors pollicis longus and brevis and the extensor indicis proprius. The superficial radial which is entirely sensory pursues a more superficial course in the arm and continues down the



Fig. 3. In this patient there is paralysis of extension of the finger and thumb of the left hand with an advanced degree of flexor contractures. The wrist can still be weakly extended. The wasting of the forearm is quite noticeable (Case 2).



Fig. 4. The dot on the left upper forearm indicates the point beneath which there is extreme tenderness. This corresponds to the location of the bicipitoradial and interosseous bursa of the elbow. There is an exactly similar point in the first case. (Case 2).

radial border to supply the sensory area of the radial nerve on the back of the thumb and the anatomical snuff box.

The anatomical fact which we believe to be highly important in the explanation of the paralysis of the dorsal interosseous nerve is the relationship of the nerve to two bursae of the upper forearm. Just before the nerve penetrates the supinator brevis it skirts lateral and posterior to the bicipitoradial and interosseous bursae of the elbow. It is closely applied to the posterior walls of these bursae. No mention of this relationship is made in the standard texts on anatomy. As a matter of fact only the most meager descriptions of the bicipitoradial bursa could be found on consulting Cunningham's, Gray's, Hirsch's and Morris' anatomies and there was no mention made whatever in these works of the interosseous bursa of the elbow. However in Toldt's *Atlas of Anatomy*, section on myology, these two bursae are well depicted and described as follows: The interosseous bursa of the elbow is in contact with the interosseous membrane and the oblique ligament posteriorly, projecting forward it separates the tendon of the brachialis anticus on the inner side from the tendon of the biceps and the upper part

of the insertion of the supinator brevis on the outer side. The bicipitoradial bursa lies medial to it separated partly by the tendinous insertion of the biceps tendon. These two bursae apparently facilitate the movements of the biceps tendon. Figure 5 indicates the close application of the dorsal interosseous nerve to these bursae.

DEDUCTIONS FROM ANALYSIS OF CASES

Evidence can be adduced from the analysis of the reported cases to indicate that the syndrome of progressive paralysis of the dorsal interosseous nerve is a consequence of changes produced in the nerve by pathological alterations in the wall of these bursae and in the tissues immediately adjacent to them. In respect to this hypothesis several pertinent questions arise. First whether there is evidence already existing that a bursitis can cause alterations in a nerve sufficient to produce neuritic signs. Second whether there are in these cases of paralysis of the dorsal interosseous nerve evidences pointing to the probable presence of a bursitis. Third whether the recorded instances of paralysis of this nerve contain in their histories circumstances predisposing to a bursitis affecting these bursae and last whether

the literature contains references to injury of the dorsal interosseous nerve by disease of these bursæ

Though the significance of the bursæ of the body is generally overlooked in the neurological literature, several bursæ diseases are known to cause neuritic manifestations in nearby nerves

O'Conner and again Elgart reported cases of traumatic inflammation of the iliopsoas bursa which, owing to its contiguity to the femoral nerve, caused severe pains in the distribution of the nerve and atrophy of the quadriceps group. Weakness of the leg, atrophy of the thigh, radiating pains, local tenderness and dragging of the toes, followed a bursitis provoked either by a traumatic incident as a sudden twist or else following repetitive trauma occurring in the course of the patient's occupation. Again inflammatory changes in the ischiogluteal bursa, the so called "weavers bottom," caused by constant trauma may produce neuritic symptoms in sciatic nerve. The fact that bursitis may cause neuritic signs is apparently well established at least in the orthopedic literature

In reviewing the case reports of paralysis of the dorsal interosseous nerve, one is struck by the frequent references to the presence of either pain at some time in the course, or else by the presence of tenderness of the affected arm on examination. Apparently no significance has been attached to this phenomenon and no attempt made to relate it to the paralysis. Woltman and Learmonth gave merely a passing reference to the fact that several patients had pain in the arm

In the case of Guilan and co workers the patient was an orchestra leader who suddenly noted weakness in his right small finger. This was followed in 10 days by involvement of the fourth and third fingers. In addition to the extensor weakness the author noted a point of great tenderness over the dorsal interosseous nerve where it entered the substance of the supinator brevis

In the third case of Woltman and Learmonth the patient 2½ months after an appendectomy accompanied by fever noted weakness of the small finger, which was followed in a week by paralysis of extension of the other fingers. There was a tender point over the dorsal interosseous nerve 7 centimeters below the elbow joint

In their fifth case the patient developed over the course of 6 months paralysis of extension of all the fingers and the thumb, and wasting of the forearm. She complained of sharp twinges of pain in her upper forearm. She habitually slept with her head pillowed on her right forearm

In the case described by Hobhouse and Heald, rapid onset of weakness of extension of the fingers

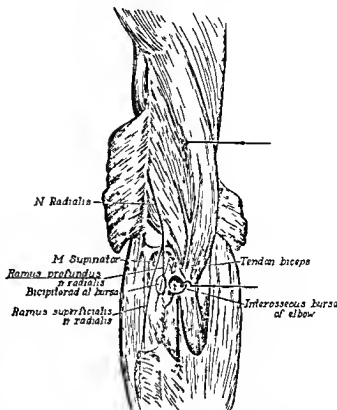


Fig. 5 The semi-diagrammatic drawing is adapted from Todd's *Atlas of Anatomy*. The course of the ramus profundus n. radialis (dorsal interosseous) has been drawn in to show its relation to the bursa. The 'interosseous bursa of the elbow' has been drawn mesially and actually overlaps a short portion of the nerve. The nerve passes behind the bicipitoradial bursa.

was ushered in by a severe dull pain in the region of the elbow. The patient held the arm in flexion to avoid pain. The pain gradually eased, but on subsequent observations, the paralysis of the muscles supplied by the dorsal interosseous nerve became more complete and wasting of the forearm occurred. No sensory signs were noted

In Jumentie's case, weakness of the fifth, fourth, and second fingers appeared accompanied by a tender swelling across the dorsum of the wrist and up the forearm. These were interpreted by the author as due to a tenosynovitis involving apparently the synovial sheaths of the wrist and of the tendons of the common extensor. While this case is not strictly comparable to the others, it serves to illustrate the point that inflammations of the synovial membranes may affect the adjacent nerves. Structurally the bursa and the synovial sheaths are identical, consisting of a fibrous sheath lined with endothelium

The 2 cases here reported both showed a point tender to deep pressure approximately over an area beneath which lay the bicipitoradial and interosseous bursæ of the forearm

Thus in the 12 cases now reported there are direct evidences of pain in the arm and of tenderness on examination in 6

Since the dorsal interosseous nerve is purely motor it is obvious that pain could not be a symptom nor tenderness a sign of primary involvement. On the other hand the type of pain and the area of distribution does not conform to an affection of the superficial radial nerve for in that case the pain should be referred to its area of innervation and the tenderness should be found along its course neither of which has been the case. Moreover pathological processes in a sensory nerve acting over long periods of time should be expected to produce abnormalities of sensation in the cutaneous distribution. This has not been seen in any of the cases.

In view of these considerations it is evident that the source of the pain must be sought for in some local process one capable of causing pain and at the same time producing neuritic symptoms in the dorsal interosseous nerve. More particularly this process must be primarily non neurogenic since notwithstanding the presence of pain there are no signs of radial sensory nerve implication. The clinical histories and findings in the quoted cases viewed in connection with the anatomical relationships of the nerve make it highly probable that the dorsal interosseous nerve is injured by inflammatory reactions occurring in the walls of the contiguous bicipitoradial and interosseous bursae of the elbow. The bursae of course are supplied by nerves mediating deep sensation and it is the irritation of these that provide the source of the pain.

According to Campbell and Hertzler trauma causes effusions into the bursal sacs with inflammatory changes taking place in the bursal wall and adjacent tissues. The bursitis may be excited by either direct blows or pressure over the bursae or may result from sudden strains imposed on the tendons attached to the bursae. Repetitive traumas resulting from some special occupation may also excite these reactions. Aside from trauma acute or chronic bursitides may occur by the localization of an infectious process much in the same way as particular joints are affected in the non suppurative arthritides. An isolated bursitis may occur in the course of rheumatic infections. Since the structure of the bursae is very simple inflammation due to different origins manifests itself in identical pathological processes. In some types of bursitis no fluid may be secreted by the endothelial cells and the bursae may remain painful for years. In others pain occurs early but disappears as fluid is transuded into the

bursal sac. In still others pain may never be of any consequence as fluid is poured into the sac upon the first insult. The presence of bursitis in this last group will be indicated only by the eventual changes in the neighborhood muscles and nerves. In glancing over the cases reviewed here it appears that the differences in the clinical picture depend upon the type of bursal reaction.

In Guillain's case of an orchestra leader the presumptive bursitis appears due to chronic traumatism. In Woltman's and Learmonth's third and fifth cases, in the case of Hobhouse and Heild the underlying cause appears to be infectious. In our first case the wrenching of the arm by a crank handle preceded the onset of the paralysis. The constant flexion movements of mulling very likely served to aggravate the condition. It is curious that there was not more pain in the elbow at the time of the accident but if a prompt bursal effusion took place little pain would be expected. The tender point on the forearm now present indicates the probable presence of inflammation in the underlying bursae.

In Case 2 the constant occupational strain on the left arm and the repetitive jerking movements appear to be adequate traumatic cause for a bursitis. The tender deep seated nodule is strongly suggestive of a bursal cyst.

In addition to those cases in which bursal inflammation may be inferred because of the presence of either pain or tenderness there are cases in which though these are lacking other factors suggest that bursal disease may have been present.

Grigoresco and Iordanesco report the case of a young man who had a sprain of the arm and then slept with his head pillowed on this arm. He rapidly developed a paralysis of extension of his thumb and index finger. There was no history of pain and the authors did not specifically mention whether or not tenderness was present. However the paralysis following trauma is suggestive.

Woltman's and Learmonth's second case was a 37 year old woman who at the age of 13 following a great deal of piano practice developed weakness of the fifth finger and then later weakness of the other fingers. She was not seen until 24 years later. No mention is made of either pain or tenderness but the long lapse of time makes accurate historical reminiscence unlikely. The association of constant piano exercises with the onset of the paralysis is again suggestive.

Silverstein reports the case of a man who preceding the onset of weakness of the small finger of his right hand used a typewriter which he stated caused over exertion of his fingers. In addition he had been playing the violin several hours daily.

No statement is given regarding the occurrence of pain or the finding of tenderness. Certainly the story of constant overuse of the right arm at least provides the basis for the production of a bursitis.

It is noteworthy that of the total of 12 cases now reported, 8 of them were in the right, the arm most commonly used, and in Case 2 the left arm, the one most used, was affected.

In order to support the assumption that paralysis of the dorsal interosseous nerve depends upon its proximity to diseased bursæ and that the anatomical relationships permit this to occur, I refer to a case heretofore unmentioned in the literature of this subject. In 1863 D Hayes Agnew presented the case of a young woman who over the period of 2 years painlessly developed a paralysis of the extensors of the fingers as well as of the flexors. On deep palpation there was a small deep seated tender nodule on the inner side of the biceps tendon. Operation disclosed a small bursal cystic sac connected to the bicipitoradial bursa. The median nerve invested the anterior surface and the posterior interosseous nerve was closely applied to and compressed by the posterior wall. Nancrede states that he has seen a case with considerable inability to use the forearm due to the enlargement of the bursa between the origins of the common extensor and the extensor carpi radialis brevis. This caused pressure on the dorsal interosseous nerve. Since the patient of Agnew recovered, it may be that if our hypothesis is true, the changes in the nerve are not as irreparable as we are led to think by the pessimism expressed in the published cases of so called idiopathic paralysis of this nerve.

All evidence appears to indicate that the causes of this unusual phenomenon of an isolated paralysis of a peripheral nerve are interstitial inflammatory and fibrotic changes within it due to the contiguity of diseased bursæ.

Future surgical verification is of course necessary, but this theory provides a logical basis for operative attack.

SUMMARY

Two cases of paralysis of the dorsal interosseous nerve are reported, both showing painful points corresponding to the position of the bicipitoradial and interosseous bursæ of the elbow. An analysis of the 10 cases in the literature appears to show that pain in this region is frequent in association with paralysis of the dorsal interosseous nerve. A bursitis affecting the aforementioned bursæ and involving the contiguous nerve would seem to explain the clinical picture adequately. It is shown that the anatomical relationships of the dorsal interosseous nerve to these two bursæ make this explanation tenable. The histories of all the cases directly or indirectly suggest the probability of a bursitis preceding the onset of paralysis.

BIBLIOGRAPHY

1. ACNEW D. HAYES. Tr. Path. Soc. Phila. 1860-1867, 2: 139.
2. CAMPBELL W. C. Dean Lewis. Practice of Surgery, Vol. 2, p. 204. Hagerstown Md. W. F. Prior Co., 1934.
3. CUNNINGHAM. Textbook of Anatomy. 7th ed. New York. Oxford University Press.
4. ELICART J. Razhlev. chir. a gynaec. 1934, 13: 220.
5. GRAY. Anatomy of the Human Body. 23d ed. Philadelphia. Lea & Febiger.
6. CRIGORESCO D. and IORDANESCO G. Rev. neurol., 1931, pt. 2, p. 102.
7. GUILLAIN GEORGES and COURTEILLANT. Presse méd. 1905, 1: 30-32.
8. HERTZLER A. E. Cyclopaedia of Medicine. Vol. 3, p. 1. Philadelphia. P. Blakiston's Son & Co.
9. HOBHOUSE N. and HEALD, C. B. Brit. M. J. 1936, April.
10. JUMENTIE J. Rev. neurol. 1921, 37: 756.
11. MORRIS. Human Anatomy. Edited by C. M. Jackson. 9th ed. Philadelphia. P. Blakiston's Son & Co., 1933.
12. NANCREDE. Internal Encycl. Surg. vol. 2, p. 711.
13. O'CONNOR D. S. Surg., Gynec. & Obst., 1933, 57: 764.
14. PIERSON. Human Anatomy. 9th ed. Philadelphia. J. B. Lippincott Co. 1930.
15. SILVERSTEIN A. Arch. Neurol. & Psychiat. 1937, 38: 885.
16. TOLDR. An Atlas of Human Anatomy for Students and Physicians. Rev. ed. New York. The Macmillan Co. 1926.
17. WOLTMAN H. W. and LEARMONTH J. R. Brain 1934, 57: 225.

PULSION DIVERTICULA OF THE HYPOPHARYNX

A Review of Forty-One Cases in Which Operation Was Performed and A Report of Two Cases

STUART W. HARRINGTON, M.D., F.A.C.S. Rochester, Minnesota

DIVERTICULA may occur in any part of the esophagus. In 1840 Rokitsky classified them in two general groups: pulsion diverticula and traction diverticula. The pulsion diverticula are most commonly situated in the hypopharynx close to the junction of the pharynx and the esophagus; they usually are known as pharyngo-esophageal diverticula. In a strictly anatomical classification it would be more correct to classify them as pharyngeal diverticula. However, because of their close proximity to the esophageal orifice as well as the fact that most of the symptoms produced by them are referable to the esophagus, the term pharyngo-esophageal is more descriptive for this type of pulsion diverticula. The term pharyngeal diverticula should be reserved for those rare types that occur in other portions of the pharynx. Traction diverticula most commonly occur in the true esophagus and will not be considered in this paper.

The pulsion diverticula are the most common diverticula that occur in the pharynx. They have a rather constant situation in the posterior wall of the pharynx close to the midline and usually occur at a site of muscular deficiency between the inferior constrictor and cricopharyngeus muscles of the pharynx. The opening is usually situated to the left of the midline although it may occur to the right of the midline.

The uniform situation of these diverticula which are essentially herniations of the mucous and submucous coats of the pharynx suggests a possible congenital origin. In this respect they are somewhat analogous to one of the hernias that occurs at the esophageal hiatus that is diaphragmatic hernia. In the latter type of hernia an enlarged esophageal ring has been present since birth but the hernia does not develop until later on in life, as a result of constant and increased pressure on the congenitally weak area. There is considerable difference of opinion as to the cause of these diverticula. Many theories

have been advanced. Some are based on neuromuscular inco-ordination during the act of swallowing; others have a physiological basis that is increased pressure in the posterior part of the pharynx and others are based on areas of muscular deficiency at the points of entrance of nerves, blood vessels and lymphatics through the muscles of the posterior wall of the pharynx. It is probable that muscular deficiency is the predisposing cause and that other factors are the inciting causes in the production of the diverticula. This would tend to explain why the symptoms associated with the diverticula are progressive and do not present definite form until late in life.

I have recently reviewed the clinical manifestations in the 227 cases of pharyngo-esophageal diverticulum in which operation was performed at The Mayo Clinic. In 83 per cent of cases the symptoms were vague and indefinite at the onset and were slowly progressive; that is they had been present 1 to 18 years before they produced any marked disability. In 15 per cent of the cases the symptoms were more rapid in their progress and severity. This difference in the progress of early symptoms of the disease seems to be more related to the character of the neck of the sac than to the size of the sac. In many instances relatively small diverticula which have a small opening produce very marked and disabling symptoms while large diverticula which have a large opening produce relatively little distress and disability because the contents of the sac can be more easily emptied. However in both of these types the larger the diverticulum the greater is the severity of the symptoms which may progress and produce complete esophageal obstruction.

The earliest symptom usually is dysphagia; there is a sensation of some foreign body obstructing the normal process of swallowing and food seems to stick in the throat. Later there is regurgitation of food and mucus. These symptoms do not occur until a definite sacculation is formed. There often are noisy deglutition and gurgling noises in the throat; these result from the swallowing of air and the collection of food in

the sac. If the food is not regurgitated the sac can often be emptied by pressure on the side of the neck, especially on the left side, as most of these diverticula project to the left of the midline at about the level of the thyroid gland. After the sac has become rather well developed the progress is rapid because of the increased pressure within the sac, which is caused by the more or less constant presence of food and secretions. The sac pushes downward and backward, between the prevertebral or pretracheal fascia, into the mediastinum and may extend to the arch of the aorta. The largest sac found in any of the cases filled the entire superior mediastinum and held approximately 700 cubic centimeters of fluid. As the diverticulum enlarges it produces progressive esophageal obstruction because the enlarging opening of the diverticulum is pulled downward and forward and obstructs the normal esophageal orifice. This orifice often becomes a narrow slit and may be pushed laterally. The portion of the upper part of the esophagus that is in apposition with the diverticulum is flattened and distorted by direct pressure of the body of the sac. Food enters the diverticulum first and then overflows into the esophagus. In many instances the patients spend hours at their meals in order to obtain enough nourishment to sustain life. The loss of weight may become very great. One patient had lost 100 pounds (45.4 kg) before coming to the clinic. When the large sacs that extend into the mediastinum are filled with food they produce marked pressure on the adjacent intrathoracic organs and cause a distressing sensation of fullness in the thorax; this sensation is often associated with dyspnea, palpitation of the heart, and a sense of suffocation. Severe cough and choking spells occur frequently and patients many times will lower their heads, as is done in postural drainage, and they will press on the side of the neck in order to empty the sac. In some instances the food will enter the trachea and cause marked cyanosis and may result in a pulmonary complication. There is often an associated hoarseness of the voice; this is caused by pressure or inflammatory reaction around the recurrent laryngeal nerve which is often close to the neck of the sac.

The symptoms of pharyngo esophageal diverticulum are definite and characteristic after the sac has been definitely formed, and the diagnosis is readily established. In the earlier stages the symptoms are not definite and a clinical diagnosis may not be established unless an esophagoscopy or roentgenological examination is made. These methods are the most accurate means of establishing a definite diagnosis in all cases. They

should be employed in all cases in which there are any persistent signs of dysphagia, as the longer the diagnosis is delayed, the greater is the risk of serious complications which may enhance the difficulties and may impair the results of surgical treatment.

Although these diverticula were first recognized more than 170 years ago by Ludlow (1764), they were not treated surgically until 60 years ago, when Nicoladoni produced a cervical fistula by diverticulotomy. This procedure obviously could not effect a cure. Nelhans, in 1884, is said to have been the first one to perform a primary diverticulectomy, but the operation was not successful. The first successful operation for the condition was reported by von Bergmann in 1892. These early operations were associated with a relatively high mortality, chiefly because of mediastinitis, pneumonia, and pulmonary abscess. In many of the cases in which the patients recovered, the morbidity was great because of an esophageal fistula. This led to the two stage operation, which Goldmann, of Freiburg, is credited with introducing in 1909. After the introduction of this procedure the mortality was greatly reduced. It is now generally accepted that complete extirpation of the diverticulum by operative measures is the only method of treatment that will produce complete relief of symptoms, but there is still considerable difference of opinion as to whether diverticulectomy should be done by a one stage primary procedure or by a two stage procedure. The majority of surgeons favor the two-stage procedure but there are many surgeons of equally wide experience who have obtained excellent results with the one stage procedure.

The purpose of this paper is to report a series of 41 cases in which I have operated for pharyngo esophageal diverticulum by utilizing both the one stage and two stage procedures and to describe the operative treatment.

In this series of 41 cases I utilized both the one stage and the two stage operations. It is generally accepted that the only effectual surgical procedure for pharyngo esophageal diverticulum is the complete removal of the sac, including its neck. In the two operative procedures advocated to accomplish this purpose, the technical difference is in the treatment of the sac and the time at which the sacculation is removed. In the one stage procedure the sac is removed at the primary operation and in the two stage procedure a temporary diverticulostomy is performed, and the sac is removed at a second operation 7 to 10 days later. The fundamental difference in these two procedures is that in the one stage operation

the fascial planes leading to the mediastinum are not walled off preliminary to the removal of the diverticulum. In the two stage operation the interval between the operations permits the formation of granulations which wall off the fascial planes of the neck and mediastinum.

Because pharyngeal fistula that follows diverticulectomy is one of the most common causes of cervical cellulitis and mediastinitis an indwelling stomach tube should be inserted before the diverticulum is removed. This permits postoperative feeding. In the one stage operation the tube is inserted before the primary procedure and in the two-stage operation it is inserted before the second operation.

The method of approach to the diverticulum is the same in both operations. The approach is made on the side of the neck on which the diverticulum is situated which is usually the left side. In the roentgenogram many of these sacculations appear to be in the midline but the neck of the sac is usually situated to the left or right of the midline. The true situation of the neck of the sac can be best determined by the preliminary esophagoscopic examination. The incision should be made on the side of the neck on which the opening is found. This I believe is important as the exposure of the neck of the sac is greatly facilitated and there is less risk of injury to surrounding structures particularly the recurrent laryngeal nerve.

For anesthesia I prefer regional nerve block with procaine. When this method of anesthesia is used the patient's reflexes are not destroyed this is helpful in safeguarding the patient in many instances. If there is an accumulation of secretions in the sac at the time of operation these secretions can be carefully emptied into the pharynx they may either be aspirated by suction or swallowed by the patient. The act of swallowing is often helpful in identifying some of the small diverticula as air is forced into the sac which permits it to be recognized readily. In the cases in which the diverticula are large there is rarely any difficulty in recognizing the sac. It is also helpful to be able to talk to the patient during the course of the dissection around the neck of the sac posteriorly because of the close proximity of the recurrent laryngeal nerve. This is particularly true in those cases in which there is considerable inflammatory reaction in the sac and surrounding tissues which makes visualization of the nerve difficult.

An incision is made through the skin and platysma myoides muscle the incision extends along the anterior border of the sternocleid-

mastoid muscle from the hyoid bone above to a point about 3 centimeters above the clavicle (Figs 1 and 2). The external jugular vein is often in the line of incision, in this case the vein is cut and ligated. The sternocleidomastoid muscle is then separated laterally from the underlying omohyoid muscle. The latter is usually retracted medially or cut this exposes the carotid sheath laterally which is retracted outward with the sternocleidomastoid muscle. The thyroid gland is exposed beneath the omohyoid muscle and retracted inward this exposes the pretracheal fascia which surrounds the trachea and esophagus. In cases in which there is an appreciable hypertrophy of the thyroid gland it may be necessary to do a partial lobectomy in order to obtain adequate exposure of the fascial coverings of the esophagus. The fascia is then incised posteriorly to the trachea at about the level of the cricoid cartilage. The diverticulum usually is readily localized it extends downward laterally and posteriorly to the esophagus. The fascial coverings of the diverticulum are then carefully dissected away until the true wall of the sac is reached. The fundus of the sac is then carefully elevated into the wound and the dissection of the remainder of the sac including its neck is carried out as it appears through the muscles of the posterior lateral wall of the pharynx usually between the lower border of the inferior constrictor muscle of the pharynx and the cricopharyngeus muscle. Great care should be exercised in this dissection so as not to perforate the sac at any point or injure any of the surrounding structures particularly the recurrent laryngeal nerve which is in close relation to the neck of the sac in many instances. It is important not to separate the fascial planes more than is necessary to remove the body of the sac and to make a very accurate separation of the neck of the sac from the surrounding pharyngeal muscles.

Up to this point the technique of both the one stage and two stage procedures is identical.

In the first stage of a two stage operation (Fig 1) after the diverticulum has been completely dissected from its surrounding attachments I place a loop of black silk around the true neck of the sac at its junction with the pharyngeal wall this loop is not tied or permitted to obstruct the neck of the sac in any way. The silk must be very carefully stitched to the outer wall and must not penetrate the wall of the sac. The free ends of this silk loop are brought out of the incision and fastened to the skin. The purpose of this loop is to act as a guide to the neck of the sac so as to insure the accurate removal of the entire sac at

the second operation. It has been my experience that, after the first operation, there is often a marked inflammatory edema not only of the walls of the diverticulum, which become greatly thickened, but also of the surrounding tissues, particularly at the junction of the pharynx. This reaction interferes with an accurate localization of the true neck of the sac at the second operation. I have found this procedure very helpful in obviating this difficulty and it insures against the possibility of excising too much of the sac, which may result in a fistula and subsequent stricture, it also prevents leaving too much of the neck of the sac, which usually causes difficulty and often results in a recurrence of the sac. The diverticulum is then brought out of the upper angle of the wound and sutured to the surrounding muscles in an effort to turn the opening of the sac downward and promote drainage of the sac and to prevent it from becoming filled with secretions and ingested food. A small soft rubber tube and some gauze are placed in the pocket occupied by the diverticulum in the neck or mediastinum and the wound is closed. If the diverticulum is of sufficient size to protrude beyond the skin that portion of the sac is covered with vaseline gauze. The time of election for the second operation depends on the individual indications in each case. Inasmuch as the purpose of the two stage procedure is to permit the fascial planes to become walled off, I believe that at least a week should elapse before the second stage of the operation is done and in some instances it is advisable to wait two weeks. At the second operation the diverticulum is carefully dissected from the wound and the black thread that was placed around the neck of the sac is removed. The neck of the sac is then transfixed and ligated with chromic catgut at this point and the sac is excised close to the ligature. The remnant of mucous membrane distal to the ligature is treated with silver nitrate and alcohol and the stump is dropped back. A gauze and tube drain is placed below the stump and the wound is closed with interrupted sutures. The patient is not permitted to take anything by mouth for at least 1 week, but is fed through the indwelling stomach tube which was inserted through the nose.

In the one stage operation the true neck of the sac is transfixed and ligated with chromic catgut after the sac has been completely dissected free from the surrounding structures (Fig. 2). The redundant mucous membrane is treated with silver nitrate and alcohol and is then dropped back. The muscle of the wall of the pharynx, which surrounds the neck of the sac, is loosely

approximated with interrupted sutures of catgut. A gauze drain is placed in the pocket formerly occupied by the diverticulum and a soft rubber tube is placed down to the repaired pharyngeal wall, the wound then is closed with interrupted sutures. The patient is fed entirely through an indwelling stomach tube for 7 to 10 days.

In this series of 41 cases, 29 of the patients were men and 12 were women. The average age of the patients was 58 years. The youngest patient was a man, aged 35 years, and the oldest patient was a woman, 73 years of age. The interval between the onset of symptoms and the operation varied from 9 months to 18 years, the average interval was more than 5 years. In 1 case, in which the patient was 65 years of age, a diagnosis of pharyngo esophageal diverticulum had been made 18 years before the patient came to the clinic for emergency treatment of acute complete esophageal obstruction and associated weakness and emaciation that had been caused by the loss of 100 pounds (45.4 kg). Two attempts were made to pass a stomach tube through the esophagus with the aid of an esophagoscope, but it was impossible to locate the esophageal orifice because of inflammatory edema. It was necessary therefore to do a gastrostomy in order to feed the patient preliminary to operation. In 5 other cases it was necessary to insert an indwelling stomach tube through the esophagus for feeding preliminary to operation.

The operative procedure was a complete diverticulectomy in all cases. In 25 cases the sac was removed by a two stage operative procedure, the sac in most of these cases was large and extended into the mediastinum in many instances. In some cases there was an associated diverticulitis. In 16 cases the sac was removed by one stage operation, in all of these cases the sac was small to moderate in size and in only 1 case did the sac extend into the superior mediastinum. In 2 cases a partial thyroidectomy was done at the time of the first operation.

There was 1 operative death in the entire series. In this case death followed a two stage procedure, there had not been any leakage from the sac or pharynx. The patient was in poor physical condition not only because of the large pharyngo esophageal diverticulum, which had caused marked esophageal obstruction, but also because of arteriosclerosis of the central nervous system and a well advanced Parkinson's syndrome. A marked psychosis developed on the third postoperative day. There was swelling of the throat, a temperature of 102 degrees F on the fifth day after operation, and moderate drainage

from the wound. The condition of the patient became progressively worse, by the ninth day after operation the diverticulum had become somewhat necrotic. It was removed and the wound was explored. That portion of the diverticulum below the margin of the skin was not necrotic and there had been no leakage. There was a marked cellulitis in the cervical region with a moderate mediastinitis. The removal of the sac and exploration of the wound did not influence the progress of the condition in any way. The condition of the patient became progressively worse and he died on the eleventh day after the initial operation. The immediate cause of death was a terminal pneumonia. A roentgenogram of the lungs which was made on the sixth day after the operation reveals no abnormality. While this death is charged to the operation (two stage operation) there were many unrelated contributing factors and the result would probably have been the same regardless of the type of operation. The fact that there was considerable cervical cellulitis indicates that the multiple stage procedure may not entirely protect against this possible complication.

In 3 cases hoarseness occurred following a two-stage operation. In 2 cases the hoarseness was temporary and there was no paralysis of the vocal cords but in 1 case there was a paralysis of the left vocal cord which was caused by injury of the recurrent laryngeal nerve. In 1 case temporary hoarseness occurred following a one stage operation.

The average duration of convalescence before dismissal of the 23 patients who were subjected to two stage operations was more than 5 weeks. A temporary fistula developed in 6 cases in all of these cases it healed without further surgical intervention in 1 week to 2½ months. The average duration of postoperative convalescence before dismissal of the 16 patients who were subjected to a one stage diverticulectomy was a little less than 3 weeks. Postoperative complications occurred in only 1 of the cases in which the one stage operation was employed. In this case temporary pharyngeal fistula developed. This fistula was probably precipitated by the patient drinking a considerable quantity of fluids the second night after the operation although he was instructed not to do so. The fistula persisted for 3 weeks and then healed. In 1 additional case there was a moderate amount of seropurulent drainage. In the 14 remaining cases the wounds healed by first intention.

The results following the one stage operative procedure have been very satisfactory and be

cause of the shortened convalescence and lessened discomfort in eliminating one operative procedure. I believe that the one stage procedure should be utilized in all cases in which it is indicated.

I see that a roentgenogram of the esophagus is made in all cases before the patients are dismissed from the hospital and I request all patients to return in 6 months to a year for re examination. All but 7 of the patients in this series of cases have returned for examination at some time following operation. The examination has included a roentgenogram of the esophagus. All but 4 patients have either returned for examination or replied to a letter of inquiry as to their condition in the 6 months before this paper was written.

The late results following the two stage operation have not been as satisfactory as those following the one stage operation.

In 2 cases in which the two stage operation was employed the diverticulum has recurred 1 to 2 years after operation. In 1 of these cases the patient had a large adenomatous thyroid. There were 5 patients who had some difficulty in swallowing certain types of food. These patients stated that they had a sticking sensation in the throat. No definite recurrence or stricture was found on subsequent examination but a slight angulation was found at the site of the removal of the neck of the sac in 4 of the cases in which this occurred symptomatic relief was obtained by dilatation. In the fifth case the symptoms were partially relieved by dilatation. There were 9 patients who did not receive complete relief from the original operation but 4 of these were subsequently relieved by dilatation. It is of interest to note that in 6 of these 8 cases the diverticulum was classified as small or moderate in size. There were only 2 cases of large diverticulum in which a good result was not obtained.

REPORT OF CASES

CASE 1. A man aged 50 years came to the clinic July 23, 1931 because he regurgitated ingested food. Ten years before this he had noted that a large amount of mucus accumulated in his throat during the night and he would have to expectorate before he could eat breakfast. Later he had noted that food taken during the day would be regurgitated at night. He complained chiefly that food did not reach his stomach until enough of it had been taken seemingly to fill a pouch in the right side of his neck. After this pouch was filled the food seemed to overflow into his stomach. He had learned to empty this pouch of retained food by applying pressure to the right side of his neck and to wash out the pouch with water. Until 2 years before his admission he had been able to maintain his weight rather well by eating at frequent intervals and by taking considerable time at his meals. In the last 2 years before he came to the clinic he had had increased difficulty

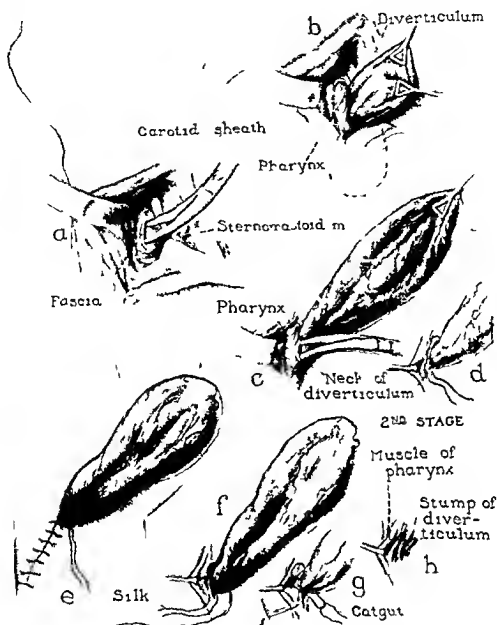


Fig 1 Two stage operation a incision along anterior border of sternomastoid muscle and incision of the pretracheal fascia over the diverticulum b beginning dissection of the diverticulum from the superior mediastinum c dissection of the neck of the diverticulum at the pharyngeal opening d neck of the sac marked with black silk, e diverticulum sutured outside the wound Second stage of operation f placing black silk around the neck of the diverticulum g ligating the diverticulum with catgut, h closure of opening in the pharynx around the neck of the diverticulum

in swallowing and in getting sufficient food into his stomach to maintain his general condition. The regurgitation increased progressively and he had had increased difficulty in taking both liquid and solid food. During the month before his admission his condition had become much worse than it had been and he had lost about 13 pounds (5.9 kg). His normal weight was 106 pounds (48.1 kg.)

General examination was essentially negative. Roentgenographic and roentgenoscopic examinations of thorax disclosed a very large diverticulum of upper third of esophagus (Fig 3). The diverticulum extended into the right thoracic cavity. A diagnosis of pharyngo-esophageal diverticulum was made. A two-stage operation was advised.

A Rehffuss tube was inserted through the esophagus into the stomach for postoperative feeding. Operation on July 29 revealed a large esophageal diverticulum which extended deep into the mediastinum on the right side. The diverticulum was completely dissected from the surrounding structures and was brought through the wound in the right side of the neck. The sac was left protruding from the wound and the neck of the sac was sutured to the sternocleidomastoid and sternohyoid muscles (Fig 4). The second stage of the operation was done 12 days later. At this time the sac was entirely removed (Fig 5) the neck of the sac was inverted and the opening of the sac into the esophagus was completely closed.

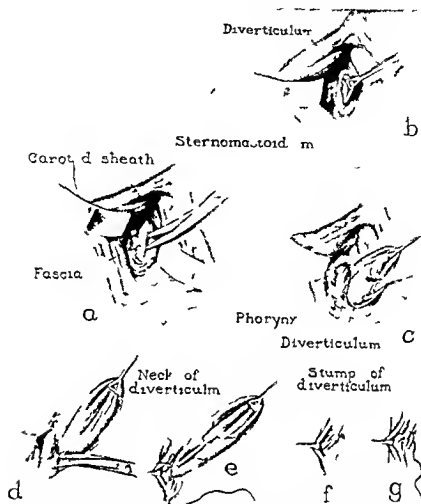


Fig. 2 One stage operation: a incision around anterior border of sternomastoid muscle with opening of the peritracheal fascia over the diverticulum; b and c dissection of the diverticulum from the peritracheal fascia; d dissection of the neck of the sac at the opening in the pharynx; e section and ligation of the neck of the sac with chromic catgut; f and g closure of the opening in the pharynx with chromic catgut.

Convalescence was uneventful. For 10 days following removal of the diverticulum the patient was fed through the Rehfuß tube which had been inserted through the esophagus before operation. He had a slight increase in temperature for about 3 days but the temperature then dropped to normal and remained so throughout the remainder of the convalescence. A moderate amount of seropurulent material continued to drain from the wound for about 2 weeks when the wound gradually closed. After removal of the Rehfuß tube the patient swallowed food without difficulty and there was no fistulous opening. When he was dismissed from observation 33 days after the operation was performed the wound was completely healed (Fig. 6).

A roentgenographic examination of the esophagus 2 days before his dismissal gave evidence of complete removal of the esophageal diverticulum; there was no obstruction or sacculature.

In this case I believe that a two-stage operative procedure was indicated because of the poor general condition of the patient (which was the result of his inability to obtain sufficient nourishment) and chiefly because of the type of pharyngo-esophageal diverticulum which was present. A huge diverticulum filled the anterior portion of the superior mediastinum and extended to the arch of the aorta. There was marked diverticulitis. These factors were responsible for the marked esophageal obstruction, loss of weight and poor general condition which necessitated preparation before surgical intervention could be undertaken.



Fig 3

Fig 3 Roentgenogram made in Case 1 at the time the patient was admitted to the hospital; this shows a large



Fig 5

pharyngo-esophageal diverticulum that fills the entire superior mediastinum and the upper part of the thorax

Fig 4 Photograph of patient in Case 1 made 3 days after completion of the first stage of the operation

Fig 5 Pharyngo-esophageal diverticulum removed in Case 1

Fig 6 Patient in Case 1, at the time of his dismissal from the hospital



Fig 6

CASE 2 A man aged 49 years came to the clinic on July 26 1937 because of dysphagia. About 2 years before this he had first noted that food and liquids would lodge in the upper part of the esophagus and he would at times have to regurgitate a small amount. In December 1936 8 months before he came to the clinic a diagnosis of pharyngo-esophageal diverticulum had been made. There had been no change in his voice or any loss of weight. About 12 years before he came to the clinic a total left pneumothorax had been performed and a diagnosis of pulmonary tuberculosis made. He had been placed on an antituberculous regimen and had continued this until he came to the clinic.

The patient weighed 132 pounds (59.9 kg). Examination of the thorax revealed hyperresonance and rather distant breath sounds. There was pressure over the base of the neck. These findings were typical of pharyngo-esophageal diverticulum. Roentgenological examination of the thorax disclosed a pharyngo-esophageal diverticulum of moderate size (Fig 7) a healed tuberculous lesion which was situated anteriorly at the level of the fourth rib on the right side and congenital cysts which involved a large part of the upper lobe of each lung. A diagnosis of pharyngo-esophageal diverticulum was made and a one-stage operation was performed. A French sound was passed and it was found that the mouth of the sac was wide open. There was no evidence of growth in the bottom of the sac nor of esophageal obstruction below the diverticulum.

A Rehfuss tube was inserted through the esophagus and into the stomach for postoperative feeding. Operation on July 31 1937 revealed a diverticulum underneath the lower pole of the thyroid gland. The diverticulum had a rather definite neck. It was completely isolated from the surrounding structures a catgut pursestring suture was passed around the diverticulum and the diverticulum was completely excised. The stump was transfixed upward. Microscopic study revealed an esophageal diverticulum which measured 2.5 by 1.5 centimeters.

Convalescence was uneventful. There were no post-operative complications and the patient was dismissed from the hospital on the fourteenth day after the operation (Fig 8) and was allowed to return to his home on the

seventeenth day. At that time the wound was entirely healed and the roentgenogram of the esophagus did not reveal any abnormality (Fig 9).

In this case I believe that a one-stage operation was indicated because the patient's general condition was good, and there had been no loss of weight and no definite esophageal obstruction. The diverticulum was of moderate size, extended only slightly into the superior mediastinum, and had a small neck.

SUMMARY

A two-stage operation was employed in 25 cases. There was 1 operative death in this group of cases. In 21 cases the patients obtained permanent relief, and in another case the patient obtained temporary relief but the symptoms eventually returned. In 2 cases the diverticulum returned. A postoperative fistula occurred in 6 cases in which the two-stage operation was used.

There was no recurrence of symptoms in the 16 cases in which a one-stage operation was employed. When 1 patient was examined 1 year after the operation he said that he had been entirely relieved of any difficulty in swallowing, but that he occasionally had noted an accumulation of mucus in the back of his throat. There was no evidence of recurrence of the diverticulum. Dilatation of the esophagus relieved the accumulation of mucus. In the 16 cases in which the one-stage operation was employed the diverticula were small or moderately large. There was no operative mortality in this group of cases.



Fig. 7

Fig. 7. Roentgen gram made in Case 2 at the time the patient was admitted to the hospital. This shows a moderately large (507 Hg.) pharyngeal diverticulum in the upper part of the thorax and extending slightly to the right of the midline.



Fig. 8

Fig. 8. Patient in Case 2 at the time of his dismissal from the hospital.



Fig. 9

Fig. 9. Roentgen gram made in Case 2 at the time the patient was dismissed from the hospital. This shows that the esophagus is normal.

It is not my intention to offer this summary as a comparison of the results obtained with one stage and two stage operations. The entire series of cases is too small to permit an evaluation of these operative procedures. Furthermore, the number and character of the diverticula and the condition of the patients were not the same in the two groups of cases in which these respective operative procedures were employed. However, this review does indicate that there is a group of cases in which the one stage operation will produce excellent results. In the majority of cases in which the two stage operation produced poor results the diverticula were rather small. This is the reason that I selected the one stage operation in this type of case; the results have been very gratifying. It may be that the results of the one stage operation would be equally satisfactory in some cases in which the diverticula are large but I do not believe that a one stage procedure should be done in cases in which a large diverticulum extends deep into the mediastinum and is complicated by inflammatory edema and prolonged esophageal obstruction.

I believe that both operative procedures have a definite place in the surgical treatment of pharyngo-esophageal diverticulum and that the surgeon should utilize the procedure which is

most suitable to meet the indications in each individual case. It is doubtful if the best results can be obtained by utilizing one operative procedure in all cases. The selection should depend on the condition of the patient, the character and pliability of the diverticulum, the size of the defect in the pharyngeal wall and the type of opening in the sac. In the case in which death occurred after a two stage operation the diverticulum was complicated by a cervical cellulitis and mediastinitis. This cellulitis was not entirely responsible for the fatality but it at least was a contributing factor. This shows that the two stage procedure does not always protect against this most dreaded complication of all esophageal operations and proves that the two stage procedure may give a false sense of security. I do not believe that the fear of the possible development of this postoperative complication should be the only indication for the selection of the type of procedure to be utilized in the treatment of the diverticula. It is possible for this complication to occur following either operative procedure.

REFERENCES

1. VON BERGMANN, J. Ueber den Oesophagusdivertikel und eine Behandlung. Arch. f. klin. Chir. 1892, 43: 1-30.

- 2 GOLDMANN E E Die zweizeitige Operation von Pulsiondivertikeln der Speiseröhre Beitr z klin Chir 1909 61 741-749
- 3 LUDLOW A Obstructed deglutition from a preter natural dilatation of, and bag formed in the pharynx Med Soc Phys 1762-1767 3 85-101
- 4 NEHRINS Quoted by Girard C Du traitement des

- diverticules de l'oesophage Ass franç de chir 1806 10 392-407
- 5 NICOLADONI K Ein Beitrag zur operativen Behandlung der Oesophagusdivertikel Wien med Wchnschr 1877, 27 605 631 634
- 6 ROKITANSKY C Divertikel am Pharynx Med Jahrb d k k oesterr Staates 1840 30 222-225

THE TREATMENT OF CARCINOMA OF THE UTERINE CERVIX

ABRAHAM GROSSMAN M D, Chicago, Illinois

IT HAS become definitely established by this time that carcinoma of the uterine cervix is curable in a significantly large proportion of cases by radiation therapy. Surgery is now but rarely employed in the treatment of cervical carcinoma except for the adenocarcinomatous variety. This and the fact that the initial radiation treatment administered to any patient usually determines the outcome have led us to present in some detail the plan of therapy employed for this condition at the Tumor Clinic of the Michael Reese Hospital.

All patients with suspected or proved carcinoma of the cervix are referred to the Tumor Clinic. Each patient is seen by a gynecological consultant and the radiotherapist who plan the management of the case jointly. Abdominorectovaginal examination is performed and the extent of the disease ascertained. The system of anatomical classification employed is somewhat similar to that adopted by the League of Nations Commission for the study of cervical carcinoma. Lesions confined to the cervix, anterior and/or posterior lips, with no involvement of paracervical or parametrial tissues and strict preservation of cervical and uterine mobility, are designated as Group I (Fig 1). Carcinoma spread to the vaginal wall, including the fornices, vault, etc., without parametrial involvement constitutes Group II (Fig 1). Invasion of one or both parametria characterizes Group III (Fig 1). Group IV consists of those patients with inguinal or iliac lymph gland metastasis, invasion of adjacent organs, or distant metastases (Fig 1). The anatomical extent of the disease is an important prognostic index. In the Group I cases, cure may be anticipated in from 60 to 70 per cent of cases whereas in Group

II the curability drops to about 40 per cent. The salvage of Group III cases amounts to from 15 to 25 per cent, while that of Group IV is nearly negligible. The determination of the anatomical extent of the disease is of some importance in planning the therapy, for the cases with extensive paracervical and parametrial infiltration will require larger doses of external radiation aimed at the parametrial tissues than will those tumors apparently confined to the cervix.

All cases of Groups I, II, and III are accepted for the complete course of radiation therapy. Group IV tumors are usually not treated unless there is severe pain of sciatic distribution or excessive bloody or purulent discharge, in which case external radiation is administered for palliative purposes. In advanced cases with severe, otherwise uncontrollable, hemorrhage preliminary extraperitoneal bilateral hypogastric artery ligation is recommended.

Punch biopsy is performed in every case at the outset of treatment. In early or suspected cases of carcinoma of the cervix, without gross tumor or ulceration, the Schiller test is performed. The test can do no more than point out a zone of pathological tissue deficient in glycogen content and consequently not staining brown with the Lugol's iodine solution. However, in the absence of visible or palpable tumor, or ulceration, this test will sometimes indicate the area that should be selected for biopsy. An attempt is made to grade each tumor as to its degree of malignancy. The general criteria of Martzloff and Broders are employed in grading the epidermoid neoplasms. The hornifying squamous epithelioma with few mitotic figures and with close resemblance of the tumor cells to one another is designated as Grade I (Fig 2). The squamous carcinoma with zones of transitional cells or the transitional cell carcinoma

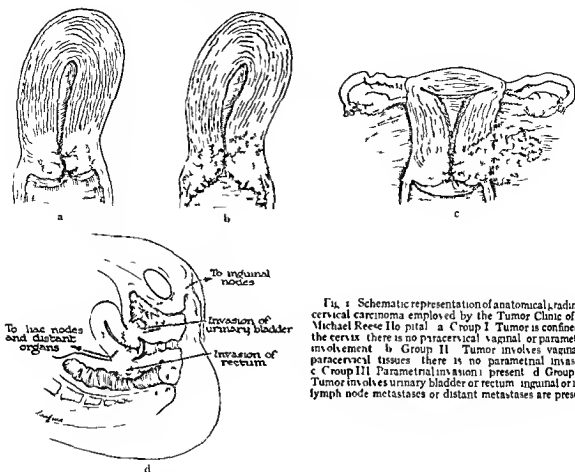


Fig. 1. Schematic representation of anatomical staging of cervical carcinoma employed by the Tumor Clinic of the Michael Reese Hospital. a Group I Tumor is confined to the cervix there is no paracervical vaginal or parametrial involvement b Group II Tumor involves vagina or paracervical tissues there is no parametrial invasion c Group III Parametrial invasion present d Group IV Tumor involves urinary bladder or rectum inguinal or iliac lymph node metastases or distant metastases are present

with squamous features is classified as Grade II (Fig. 2). Our Grade III is the pure transitional cell variety (Fig. 2). Complete anaplasia with no attempt at recognizable architectural structure with the largest number of mitotic figures and the greatest degree of individual cellular variation as to size shape and staining qualities characterizes Grade IV (Fig. 2). Grade I is least invasive, Grade IV most highly invasive while Grades II and III have intermediate degrees of malignancy. We have not been able to demonstrate any constant relationship between degree of malignancy and radiosensitivity. In general we have found all epidermoid neoplasms of the cervix to be radio sensitive.

Cervical culture is made routinely before the administration of intra uterine radiation. If the hemolytic streptococcus is found intra uterine radiation is delayed until the cervical culture has become negative for this organism.

Since one course of radiation often produces local radio immunity or radioresistance to future

radiation the first cycle of treatment must be planned to sterilize the tumor if this has not been accomplished during the first attempt. All future trials will at best be palliative in effect and not curative. In this respect the rate of administration of the energy is of extreme importance. The so called caustic method of radiation the administration of a single massive dose at one sitting has been abandoned. It is now recognized that tumor cells are most radiosensitive during the phase of cell division or mitosis and since different neoplastic cells within the same tumor may be in mitosis at different intervals it is important to deliver the radio-active energy over a protracted period of time in order to expose the maximum number of cells undergoing mitosis to the radiation. On the other hand it is important not to exceed a certain tolerance dose beyond which edema of the soft tissues surrounding the tumor occurs making for radioresistance. While protraction of the treatment is considered necessary excessive prolongation with insufficient daily in

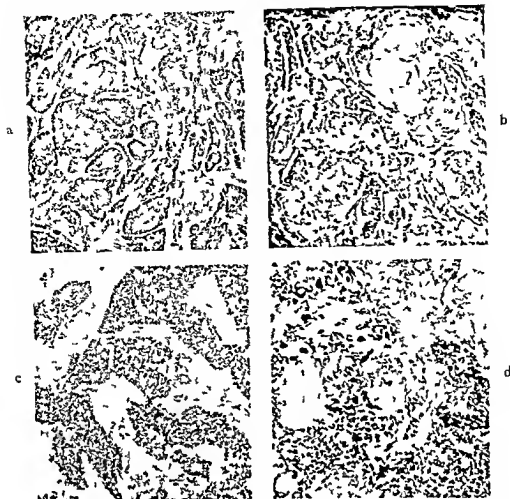


Fig 2 a Grade I epidermoid carcinoma of cervix. Hornifying squamous pearls are numerous $\times 27$ b Grade II epidermoid carcinoma of cervix. The lesion shows transitional cell as well as squamous features $\times 68$ c Grade III epidermoid carcinoma of cervix. Histological structure of purely transitional cell variety $\times 7$ d Grade IV epidermoid carcinoma of cervix. This is the totally anaplastic and most highly invasive variety of cervical carcinoma $\times 45$

tensity will usually not produce a tumoricidal effect. The optimum period of treatment is thought to be from 40 to 60 days.

The choice of the radio active agent, whether radium or x rays, is less important than the technique of radiation. In this clinic radium element has been employed for the intra uterine and vaginal radiation, while the external radiation has been administered either with the 4 gram radium pack or with a 200 kilovolt deep x ray therapy machine. Recently, a special tube has been developed for use in the accessible body cavities with which it is possible to administer roentgen therapy intravaginally. As for the external radiation employed there are certain desirable features about the radium pack. The wave length of the γ ray is shorter and consequently more penetrating than the shortest x ray obtainable with the usual 200 kilovolt apparatus. This leads to more selective destruction of neoplastic cells and better

preservation of uninvolved tissues. In addition, the rate of delivery of the energy is much slower than with x rays. On the other hand, with higher tension voltage it is possible to produce shorter wave length x rays with physical and biological characteristics resembling the γ ray.

The parametrial tissues are always irradiated whether they are clinically involved by tumor or not. The sequence of treatment, intra uterine, vaginal, or external, depends primarily on the anatomical disposition of the tumor. Each case is an individual problem and the technique and dosage are varied accordingly. However, certain general principles are followed in the management of cases of cancer of the cervix and these principles are presented in some detail. If the vagina is filled with tumor and the cervical canal occluded, external radiation is administered first (Fig 3). On bimanual examination the parametria are projected to the skin anteriorly and pos-

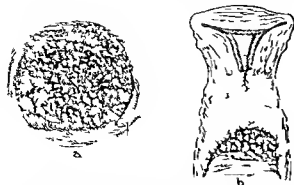


FIG. 3. Carcinoma of the uterine cervix with obliteration of the uterine canal and the fornices. a as seen with vaginal speculum. b schematic cross section. In dealing with this type of lesion external radiation is selected. a the initial mode of treatment. It is also possible to begin with a specially molded vaginal radio active applicator.

teriorly (Fig. 4). Two anterior iliac and two posterior gluteal fields are marked out. These fields must be separated by at least 1 centimeter in the midline to prevent overlapping and excessive damage to the tissues in the midline. The pudendal field is usually not employed as the skin in this region becomes readily macerated and will not stand much radiation. About 3000 milligram hours are administered daily to each of two fields for a total daily dose of 6000 milligram hours. The radium is in the form of 4 grams of element filtered by 1 millimeter of platinum and kept at a distance of 10 centimeters from the skin. The size of each field is 8 by 10 centimeters. The treatments are given 6 days a week and the four fields are treated in succession. The patient is advised to douche with 1:5000 potassium permanganate 3 times daily and is examined twice weekly. If the intravaginal disease regresses to the point of permitting intravaginal or intra uterine treatment the external radiation is temporarily interrupted and the patient is admitted to the hospital for the intracavitary treatment. If however such regression does not take place the external radiation is continued until the height of the skin reaction which usually occurs about 26 to 32 days after the beginning of treatment. By this time the patient has received about 50,000 milligram hours to each of four pelvic fields for a total of 200,000 milligram hours. If the primary lesion has not regressed enough to permit intracavitary treatment with this amount of external radiation the prognosis is generally hopeless. If x-rays are employed for the external treatment instead of radium the dose is usually 200 r to each of two pelvic fields daily. The 200 kilovolt machine is employed using 1 to 1.5 millimeters of

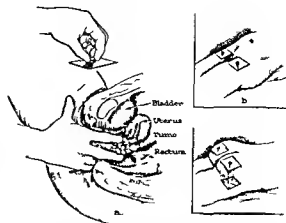


FIG. 4. a Rectovaginal examination to localize parametrial tissues in relation to overlying skin areas. b an anterior projection of parametria to anterior ilio inguinal skin areas. c posterior projection of parametria to gluteal skin areas. Usual size of portals is 11 by 11 centimeters. Some times more than 4 fields are employed especially if there is marked parametrial involvement.

copper filtration or its equivalent as Thoraeus or Thoraeus A. The skin target distance is 50 centimeters. The fields are 11 by 11 centimeters. A total of 1600 to 2000 r is given to each of 4 pelvic fields. The treatment usually being completed in 24 to 28 days. The x-ray treatment is similarly interrupted for intracavitary treatment if this becomes possible during the cycle of external radiation. Though skin, cervix and vagina are all of epidermoid structure the radiation reaction of the latter 2 usually precedes that of the skin, reaching its height from 14 to 20 days after the beginning of treatment. This reaction is known as epithelitis and consists of a pseudodiphtheritic fibrinous yellowish membrane overlying the tissues of the tumor. The remainder of the cervix and the vagina. It is a good prognostic sign if epithelitis over the tumor site precedes and is more intense than the epithelitis over the adjacent tissues. It is a distinctly poor omen if the epithelitis over the tumor develops later than that of its surrounding tissues.

The external radiation is designed primarily to reach the cells in the parametria which cannot be adequately destroyed by the intracavitary treatment. The treatment of the primary cervical tumor is accomplished by a combination of intra uterine and intravaginal treatment. If at the outset of treatment the fornices are not obliterated such intracavitary radiation is administered before the external treatment (Fig. 5). If the uterine canal is patent and the culture of the cervical secretions negative for hemolytic streptococcus a tandem or intra uterine applicator and a

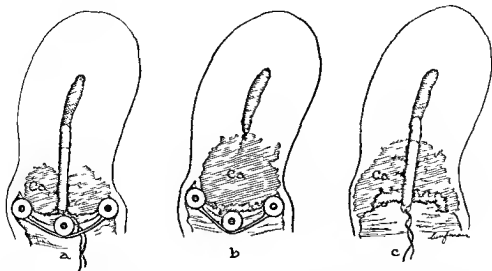


Fig 5 a Technique of intracavitary treatment for carcinoma of the cervix in which the uterine canal is patent, formices are not obliterated and uterine culture is negative for hemolytic streptococcus. Intra uterine tandem and vaginal colpostat are employed simultaneously as initial treatment. b Uterine canal is not patent but the formices are preserved. Vaginal colpostat is usually selected as the initial treatment. It is also possible to use a specially molded radio active applicator placed against the cervix. c Uterine canal is patent but the formices are obliterated. If uterine culture is negative for hemolytic streptococcus, intra uterine tandem is employed as initial treatment. As in b, it is also possible to begin with a specially molded radio active applicator placed against the cervix.

colpostat or vaginal applicator are inserted simultaneously. Fifty milligrams of radium filtered by 1 millimeter of platinum and 1 millimeter of aluminum is placed in the uterine canal and the colpostat is inserted vaginally. The latter apparatus consists of three rubber corks each containing 10 milligrams of radium filtered by 1 millimeter of platinum. One cork is left in each lateral fornix and the third is placed anteriorly to the cervical os. With such an arrangement the cervix is cross fired from multiple sources. The parametria also receive some radiation from the colpostat although 50 per cent of the intensity is lost at a distance of 4 centimeters from the colpostat cork. The abdomen must be palpated and percussed frequently to make sure that the bladder is constantly empty, otherwise a severe cystitis may develop. If the bladder remains empty and the patient is comfortable and afebrile, the colpostat may be kept in place until the tandem is to be removed. This is usually 70 hours after its insertion for a total tandem dose of 3500 milligram hours. Then the colpostat is reinserted and kept in place until it has remained for a total of 116 hours for a dose of 3500 milligram hours. If the patient is uncomfortable, if there is any elevation of temperature, or if the bladder and rectum are not emptied spontaneously, the colpostat is changed daily. If the temperature rises to 102 degrees, the intracavitary treatment is discontinued.

Following the completion of the intracavitary treatment external radiation is immediately begun, as outlined. After the intracavitary treatment the patient is instructed to douche with potassium permanganate three times daily. However, the douching should not be started prior to 48 hours following the removal of the intra uterine tandem, for while the canal is patent douching may result in pelvic peritonitis.

If hemolytic streptococcus is found on cervical culture, the intra uterine tandem is not inserted despite patency of the uterine canal but the colpostat, alone, is selected as the initial treatment. On the other hand, if the formices are obliterated but the uterine canal is patent, as occasionally happens, it may be necessary to begin with the intra uterine tandem and postpone the colpostat until the formices have opened. In such cases it may at times be desirable to give a larger initial intra uterine dose. On the other hand, if following colpostat and external radiation the uterine canal remains closed, it may be desirable to give a small additional dose with the colpostat.

Following the completion of radiation therapy, pelvic examination is performed weekly until the radiation reaction regresses. The weekly examination at this time is extremely important for fine pericervical adhesions often develop with the subsidence of the epithelitis and unless these are repeatedly broken up by the examining finger

troublesome intravaginal fibrosis may result. When all evidence of disease has disappeared and the tissues have returned to normal consistency the patient is instructed to return for follow up examination every three months. Six months following the disappearance of all evidence of tumor the resumption of sexual intercourse is permitted.

Severe backache or pain of sciatic distribution due to original or recurrent parametrial invasion is treated by subarachnoid injection of absolute alcohol according to the Dogliotti technique. This has proved to be a most satisfactory procedure for pain of somatic distribution. We have not observed relief when the pain has been due to rectal or vesical invasion or to ureteral obstruction with hydronephrosis.

For adenocarcinoma of the cervix which constitutes but 3 per cent of all cases of carcinoma of the cervix, radical Wertheim hysterectomy is recommended followed by external deep radiation provided the tumor is still confined to the cervix without parametrial invasion. If such invasion has already occurred the tumor is treated like epidermoid carcinoma of the cervix, the complete course of intracavitary and external radiation being administered.

Two factors of paramount importance in the treatment of cancer of the cervix have received far too little emphasis. These are (1) the importance of early diagnosis and institution of therapy in the curable stages of the disease and (2) the possibility of preventing the development of the disease in a majority of cases.

A recent authoritative study by a special committee of the League of Nations based on nearly 700 cases of cervical carcinoma seen and treated at the outstanding European clinics indicates that there is at least 63 per cent probability of 5 year freedom from disease following the treatment of Grade I tumors or those limited to the cervix. Unfortunately, only 9 per cent of all patients with cancer of the cervix come for treatment in this early curable stage. Over 50 per cent of the patients seen and treated have already advanced to Grades III or IV at the time of the first examination and the curability of such cases is only 1 to 23 per cent. The importance of the early diagnosis and administration of appropriate therapy in the first stage of the disease is obvious. This entails frequent periodic examination by a competent gynecologist of all women, whether presenting gynecological symptoms or not. It means not only manual examination but visual inspection of the cervix, preferably with the Hinselmann colpo-

scope. The magnification possible with this instrument will frequently demonstrate ulcerations which could not be detected by the unaided eye or even with the Schiller test. Such periodic examination will establish the diagnosis of cervical cancer in the first stage of the disease in many cases which might otherwise have passed asymptotically into less auspicious stages. Another factor of importance is the routine performance of diagnostic curettage preliminary to supracervical hysterectomy. This procedure will minimize the occurrence of stump carcinoma and will avoid the inadvertent transection of the uterus through an isthmic carcinoma promoting the dissemination of cancer cells into freshly opened blood vessels and lymphatics.

The obstetrician and gynecologist occupy the key positions not only in the establishment of early diagnosis but in the prevention of cancer of the cervix which is even more important. The disease is frequently preceded by cervicitis of venereal or obstetrical origin. In other cases abortions may be a contributory factor. The development of cancer of the cervix without antecedent childbirth curettage or venereal infection must indeed be rare. Similarly, one seldom encounters the disease in a cervix which has been cauterized surgically for cervicitis.

The steps to be taken for intelligent and effective prophylaxis are obvious: avoidance of unskilled midwifery, competent obstetrical attention at childbirth, prompt repair of birth trauma to the cervix, education of the public in the prevention of venereal diseases, thorough surgical cautery for chronic cervicitis and as mentioned before, periodic manual and visual examination of the cervix. With such a program cancer of the cervix will become not only a relatively benign, curable disease but a rare disease as well.

BIBLIOGRAPHY

1. BROOKS, A. C. Grading of cancer. *Texas State J. M.* 1933 29: 520.
2. DOGLIOTTI, A. M. Injection d'alcool dans l'espace sous arachnoïdien. *Rev. neurol.* 1931 2: 485.
3. HINSELMANN, H. Die Kolposkopie in der ärztlichen Praxis. *Monat. chr. f. Krebs.* 1937 5: 121.
4. LEVENTHAL, M. L., LASH, A. I. and GROSSMAN, A. Hemorrhage from carcinoma of the cervix. *Surg. Gynec. & Obst.* 1938 67: 102.
5. MARTELOFF, A. H. Cancer of cervix uteri. *Surg. Gynec. & Obst.* 1928 47: 183.
6. SCHILLER, W. Frühdiagnose des Karzinoms der Portio Uteri. *Monatsschr. f. Krebs.* 1934 2: 7.
7. SCHNITZ, H. R. Strahlentherapeutische Fünfjahresresultate beim Carcinoma Colli Uteri. *Strahlenther. appt.* 1938 61: 38.

EDITORIALS

SURGERY Gynecology and Obstetrics

FRANKLIN H. MARTIN
Founder and Managing Editor
1905-1935

LOYAL DAVIS, EDITOR

Associates

SUMNER L. KOCH

MICHAEL L. MASON

DONALD C. BALFOUR, *Associate Editorial Staff*

SEPTEMBER 1939

WILLIAM J. MAYO

THE Editors of SURGERY, GYNECOLOGY AND OBSTETRICS received with sorrow the announcement of the death of William J. Mayo. Closely associated with the founder of this Journal from its inception, he served as the chief of the Editorial Board for many years, during which time he contributed most generously of his time and thought. It will be difficult for anyone to measure in words his fame and influence upon the surgical world. With his brother, he introduced and directed a method of practice in medicine which, aside from his many scientific contributions, will insure his place in American surgery.

CARCINOMA OF THE CERVIX

THE treatment of cervical carcinoma in America in 1916 was almost entirely surgical. About that time radium was introduced and in a few clinics favorable results were being obtained. At all

gynecological society meetings discussions were held that predicted on the one hand the entire elimination of surgery and on the other hand, after trial, a renewed interest in the surgical attack. For many years the radiological approach has now been used and the results are much better than the anticipated ones. In the last few years in many clinics throughout the world roentgen treatment has been added to the radium treatment and the results at this writing are apparently better than with radium alone. There are still those who advocate the radical surgical extirpation of the uterus, adnexa, and lymph node drainage areas, but these advocates limit surgery to those patients in good condition with early and localized disease. It is generally admitted that radiation is the proper procedure in all but the earliest cases. The argument for surgery is that patients treated with radiation die from cervical cancer after 5 years of freedom from disease—whether this is due to recurrence or reoccurrence of the disease is not clear. In a large cancer hospital, such as the Pondville Hospital of the Massachusetts State Department of Health, very few patients have been seen or sent to the hospital who have developed cancer after a supposed 5 year "cure." No doubt patients die after 5 years following treatment but most deaths occur because of persistence of disease, not its reappearance after complete clinical "cure." Before one advocates, even in the early cases, radical surgery or surgery after radiation treatment, it will be necessary to accumulate material proving that late occurrences are due to dormant disease that could have been eradicated by operation. It is possible that small recurrences may be due to persistent disease yet

even complete surgical removal does not guarantee a cure. It is difficult to prove the necessity for radical and unquestionably dangerous surgery unless radiation failures are greater than recurrences following surgery in similar cases.

The use of preliminary roentgen ray treatment opens a new era in the management of this disease. This treatment if given in large amounts by the 200 kilovolt machine combined with moderate doses of radium, has proved of extreme value and the results of such treatment show improvement. No doubt the higher voltage machines plus radium will still further aid in the cure of this lesion.

In a series of three papers from the gynecological, urological and pathological departments of the Pondville Hospital an attempt has been made to analyze 70 cases carefully and to report important clinical deductions. The value of the Pondville method of treatment, the seriousness of renal complications and the importance of multiple biopsies are evident. Perhaps further advance in treatment other than improved radiation or surgery will come from proper management of the urological complications and from a study of the microscopic response of the tumor to radiation. Of 70 patients 23 or nearly one third died with serious urological complications. Two patients with such complications survived after proper treatment. Anticipatory treatment of such conditions and their prevention may at once increase the number of cures. The pathological study may throw light upon the advisability of surgery in certain patients. For instance those that do not show adequate response to radiation microscopically should be operated upon if operable, for the study shows that lack of response means lack of cure. Thus a reasonable method of selection of surgical cases is available. A study of the various charts indicates that five year percentages can be predicted from three

year follow up studies. The importance of this lies in the fact that intelligent changes in treatment can be made if three year responses are not satisfactory. It is the feeling of the Pondville Hospital group that better results will be obtained when more adequate treatment is used, more attention paid to urological complications and when surgery is used in operable tumors that do not respond to radiation. Just as it is evident that the adenocarcinoma or adenosquamous cell cancer of the uterus is radiation resistant so certain squamous cell carcinomas will be found to be so and will be treated by radical surgery.

It is hoped that these three papers will stimulate other investigators to carry out more intensive studies of different malignant lesions in the hope that other important lessons may be learned.

JOE VINCENT MEIGS

CANCER CONTROL IN THE RURAL SECTIONS

THE education of the American layman in the early recognition of cancer is an important phase of the warfare against this dread disease. As yet only a small proportion of our people has been reached. The cities furnish the exception where, because of proximity to hospitals and clinics, propaganda against malignant disease through the widespread dissemination of information has proved more feasible than in the rural sections. The city dweller has become cancer conscious. Educating his country cousin has been a more difficult problem as comparison of the cancer statistics of medical centers serving the rural, with those of city areas clearly shows.

Approximately 56 per cent of our total population is urban while 43.8 per cent is rural. Although it is a fact that patients living in the

More than 137,000 pamphlets were distributed in 1938 by the New York City Committee of the American Society for Control of Cancer. 196 lectures given. 11 radio talks made. Exhibits displayed 52 days.

nore densely populated sections are being cancer educated, yet nearly half of our population remains grossly ignorant concerning this important subject. The rural patient always has a tendency to resort to home remedies and bizarre forms of self medication, a situation for which the rural physician is frequently responsible. The habit of procrastination, so characteristic of the rural patient, is well illustrated by the following statement. In a series of two hundred sixty seven cases of cancer of the breast admitted to the Geisinger Memorial Hospital, a center serving a far flung rural area, it was found that the average time between the discovery of a mass in the breast and the patient's admission to the hospital was thirteen months. In a series of three hundred twenty cases of carcinoma of the colon the duration of symptoms before treatment was begun was eleven months. That when first discovered neoplastic disease is more advanced with country than with city patients is further illustrated by the following comparison of the symptoms of 200 patients with cancer of the stomach studied in a well known Boston clinic with those of 200 cancer of the stomach patients admitted to the Geisinger Memorial Hospital.

	City clinic per cent	C' ntry clinic per cent
Anorexia	40	57
Pain	30	89
Loss of weight	25	70
Vomiting	28	62
Weakness	13	54
Hemorrhage	4	24
Palpable tumor	7	50.8
Average weight loss	25.7 lbs	32 lbs

Compare two American families—one rural, the other urban. The Joneses live on a farm in the foothills of the Alleghenies, the Smiths live in a tenement in New York City. In both cases the adults are approximately sixty

years of age. The wives of these families begin to bleed from the vagina about ten years after the menopause. Although Mrs. Jones is aware of something unusual, she attaches no particular significance to it. Four or five months later, she consults her family physician—a busy country practitioner—who prescribes ergot, but who makes no pelvic examination. He does not see her again for six months. In the interim, in addition to the prescribed treatment, she tries a dozen or more home medicines recommended by relatives and friends and resorts to a multitude of bucolic, therapeutic vagaries practised in her neighborhood. (In certain sections of Pennsylvania she probably would have the trouble "pow-wow'd.") Finally if she is examined by a competent physician, the lesion is recognized, but only after the disease has become so advanced as to make treatment useless. Over forty per cent of the women of the United States are "Mrs. Joneses" living in rural sections with no more provision for adequate care than the patient cited. In fact, 17,000,000 of our people live where there are no nearby hospitals. On the other hand, Mrs. Smith of New York, sensing that all is not well, goes around the corner to the dispensary or to the nearest free clinic, where she has been in the habit of going for consultation and where she knows she will be promptly examined and efficiently treated. Her condition is diagnosed, a biopsy is made, and a panbysterectomy is performed. There are, of course, many variations of these cases, each, however, is representative of the respective groups.

Perhaps Mr. Jones, instead of his wife, is the patient. He is under weight, suffers with "indigestion," passes blood from the rectum, and has diarrhea. After suffering several months, he consults a "pile" specialist who gives him an ointment. Later his "hemorrhoids" are injected. In all probability he

does not have a digital examination—much less one with a proctoscope. After what seems an interminable period thoroughly desperate, he visits a medical center where his trouble is diagnosed as an inoperable carcinoma of the rectum. On the contrary urban Mr. Smith with similar symptoms promptly goes up the street a few blocks to a dispensary where he is informed that he is suffering from the effects of a growth in his bowel. Operated upon he is relieved—possibly cured. Cases could be multiplied indefinitely involving not only carcinoma but every ailment of a chronic nature, requiring expert investigation and accurate diagnosis—heart disease, tuberculosis, diabetes, etc.

During the 1936-1937 period the average expenditure on Works Progress Administration projects in Pennsylvania amounted to over \$20,000,000 *per thirty days*. Not a penny of this vast amount was used for medical—much less for cancer education. One wonders what one month's W. P. A. quota for Pennsylvania alone applied to rural cancer education throughout the United States might have accomplished in the prevention of unnecessary deaths from neglected and unrecognized neoplastic disease.

The Public Health Bill recently introduced by Senator Wagner calls for an increase of \$90,000,000 over and above the \$100,000,000 annually spent on public health by the Federal Government. If public tax funds are to be so used—funds which at the end of ten years it is estimated will amount to \$850,000,000 annually, there could be no more worthy expenditure of some of this money than in the advancement of cancer education among the laity—especially in the rural sections of our country. Whatever the fate of the Wagner Act with its obvious defects we are still faced by this enormously important public health problem. It might be added that such a tre-

mendous task can be accomplished only through the expenditure of vast sums of money—the only discernible source, apparently, being from the public funds. Without such adequate aid, only the surface can be scratched.

Working in an institution drawing patients from an extensive rural section, it is obvious that so far as cancer education is concerned in the country sections, but little progress is being made irrespective of the meritorious efforts of the American Society for the Control of Cancer and other agencies in the larger centers. It is true that more cancer clinics are needed but there is now probably with certain exceptions, a sufficient number of well organized hospitals to handle the rural population if patients only realized the danger and sought early aid. The question of prompt diagnosis is, therefore, largely a matter of lay education and under these circumstances lay education means large expenditures and probably out of tax funds. This is not socialized medicine, whether we like it or not. The situation in the rural sections is not being relieved as evidenced by the fact that the rural cancer patient is about as dilatory now as he was twenty years ago. But little more will be accomplished in the matter of decreasing cancer mortality until the people of our rural United States, people constituting nearly one half of our entire population, can have the opportunity of receiving systematic instruction regarding this greatest of all plagues. Instruction given under the direction of competent physicians and nurses in the rural schools and churches with readily accessible facilities for prompt examination and treatment when the individual's symptoms suggest the need of it. Such a plan should be under the control and direction of a central agency. It calls for an annual expenditure of many millions of dollars. What is to be the source of these funds? HAROLD L. FOSS

THE SURGEON'S LIBRARY

REVIEWS OF NEW BOOKS

THE book entitled *Cranio-cerebral Injuries Their Diagnosis and Treatment*¹ represents the crystallization of ideas conceived by the author in the observation of a large series of cranio-cerebral injuries at the Boston City Hospital. As a neurological surgeon with an apparently more than usual opportunity to study traumatic brain lesions Dr Munro should be qualified thus to express what are now generally accepted concepts in the rational treatment of cranio-cerebral injuries. Most of his material is not new to other neurological surgeons, some of his ideas are distinctly original and new to both neurological and general surgeons but in any event most of the advice in the book can be heeded to advantage by the general surgeon into whose hands the vast majority of head injuries first come.

Munro has rightfully emphasized the value of an accurate history of the accident and the presence or absence of unconsciousness; he deplores the use of morphine at any time in the treatment of such cases and he emphasizes the need of rest and treatment of primary shock rather than the hysterical attempts to do something for the patient such as attempting to discover immediately by x-ray whether a skull fracture be present. In view of his own statistics he finds that lumbar puncture judiciously but freely used is an invaluable even life saving measure in the treatment of the increased intracranial pressure following cranio-cerebral damage. His statistics show contrary to the experience of some other surgeons that this procedure is safe and useful both for diagnostic and therapeutic purposes. The chapter on first aid in cranio-cerebral injuries is brief but it contains information which should be in the hands of every interne and member of an emergency room staff.

Not every neurophysiologist will agree with the author on some of his statements regarding fundamental cerebral physiopathology, not every neurological surgeon will agree with him entirely in his operative treatment of hematomas. His general principles of both conservative and operative treatment as well as his treatment of complications may be regarded as sound and he also admits the necessity of variation according to one's own experience and wishes. Cranio-cerebral injuries are neurological problems or potentially so and they should be treated if possible by neurological surgeons or at least by those with an appreciation of the nervous system. Munro has failed sufficiently to emphasize this point, for he has presented his material as if he

were discussing a general surgical problem for the consideration mainly of the general surgeon.

The book is easily read for the author's style is simple and straightforward. However the last chapter comprised of a large series of illustrative case histories relative to mortality and morbidity statistics is disproportionately long. JOHN MARTIN

THE second edition of *Clinical Laboratory Methods and Diagnosis*² has appeared within the brief space of 3 years. The revision has been unusually complete. It has been lengthened from 1,088 pages to 1,607 pages and numerous new figures and color plates have been added. Obsolete and impractical tests have been replaced by the more important new tests that have been described in the past 3 years. Representative of such material are the tests for vitamin C and sulfanilamide in the blood and the Neufeld method of typing pneumococcus. It is regrettable that the Quick prothrombin time and the Ivy bleeding time, which show promise of being very useful diagnostic tests have been omitted. New features of the edition are the revision of the chapter on parasitology and tropical medicine with the assistance of Professor Pedro Kouri and the addition of a new chapter on the detection of crime by laboratory methods.

The general nature of this volume is similar to the first edition. About half the book is devoted to tests frequently performed in the physician's office laboratory whereas the other half is devoted to bacteriology, serology, parasitology, postmortem technique, tissue technique, toxicology, and methods of crime detection. Procedures have been outlined in considerable detail and the clinical interpretations are simple and direct. The author has drawn freely from recent literature on laboratory diagnosis. Reference to this material is given at the bottom of the page on which it appears. Three hundred pages are given to the section on hematology. The theories of Schilling with their clinical application and interpretations are described in detail. Schematic charts are used to illustrate the various theories of blood formation. Many of the colored plates of individual cells are small and lack detailed morphological characteristics. However the composite plates of blood smears in various diseases are very realistic and should prove very useful to the clinician. Considerable attention is given to bone marrow studies.

This book, which is almost encyclopedic in its scope, contains a variety of material rarely found in

¹CRANIO-CEREBRAL INJURIES: THEIR DIAGNOSIS AND TREATMENT. By Donald Munro, A.B., M.D., F.A.C.S. London, New York, Toronto: Oxford University Press, 1938.

²CLINICAL LABORATORY METHODS AND DIAGNOSIS. A TEXTBOOK ON LABORATORY PROCEDURES WITH THEIR INTERPRETATION. By R. H. Graef, M.D., 2d ed. St. Louis: The C. V. Mosby Co., 1938.

26

THE JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION
PUBLISHED WEEKLY
535 N. Dearborn St., Chicago, Ill. 60610
Subscription price, \$5.00 per annum in advance.
Single copies, 15 cents.
Entered as Second-Class Matter, May 2, 1912, Post Office at Chicago, Ill., under No. 102,362.
Acceptance for mailing at special rate of postage provided for in Act of October 3, 1917, authorized on July 10, 1918.
Postage paid at Chicago, Ill., and at additional mailing offices.
Copyright, 1939, by American Medical Association
Printed at the University of Chicago Press, Chicago, Ill.

THE JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION
PUBLISHED WEEKLY
535 N. Dearborn St., Chicago, Ill. 60610
Subscription price, \$5.00 per annum in advance.
Single copies, 15 cents.
Entered as Second-Class Matter, May 2, 1912, Post Office at Chicago, Ill., under No. 102,362.
Acceptance for mailing at special rate of postage provided for in Act of October 3, 1917, authorized on July 10, 1918.
Postage paid at Chicago, Ill., and at additional mailing offices.
Copyright, 1939, by American Medical Association
Printed at the University of Chicago Press, Chicago, Ill.

THE JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION
PUBLISHED WEEKLY
535 N. Dearborn St., Chicago, Ill. 60610
Subscription price, \$5.00 per annum in advance.
Single copies, 15 cents.
Entered as Second-Class Matter, May 2, 1912, Post Office at Chicago, Ill., under No. 102,362.
Acceptance for mailing at special rate of postage provided for in Act of October 3, 1917, authorized on July 10, 1918.
Postage paid at Chicago, Ill., and at additional mailing offices.
Copyright, 1939, by American Medical Association
Printed at the University of Chicago Press, Chicago, Ill.

BOOKS RECEIVED

THE JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION
PUBLISHED WEEKLY
535 N. Dearborn St., Chicago, Ill. 60610
Subscription price, \$5.00 per annum in advance.
Single copies, 15 cents.
Entered as Second-Class Matter, May 2, 1912, Post Office at Chicago, Ill., under No. 102,362.
Acceptance for mailing at special rate of postage provided for in Act of October 3, 1917, authorized on July 10, 1918.
Postage paid at Chicago, Ill., and at additional mailing offices.
Copyright, 1939, by American Medical Association
Printed at the University of Chicago Press, Chicago, Ill.

THE JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION
PUBLISHED WEEKLY
535 N. Dearborn St., Chicago, Ill. 60610
Subscription price, \$5.00 per annum in advance.
Single copies, 15 cents.
Entered as Second-Class Matter, May 2, 1912, Post Office at Chicago, Ill., under No. 102,362.
Acceptance for mailing at special rate of postage provided for in Act of October 3, 1917, authorized on July 10, 1918.
Postage paid at Chicago, Ill., and at additional mailing offices.
Copyright, 1939, by American Medical Association
Printed at the University of Chicago Press, Chicago, Ill.

CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

HOWARD C. NAFFZIGER, San Francisco, *President*

GEORGE P. MULLER, Philadelphia, *President Elect*

Committee on Arrangements

THOMAS A. SHALLOW, *Chairman* L. KRAFER FERGUSON, *Secretary*

PRELIMINARY PROGRAM FOR 1939 CLINICAL CONGRESS

THE twenty ninth annual Clinical Congress of the American College of Surgeons will meet in Philadelphia during the five days, October 16-20, and the surgeons of that great medical center are planning a most complete program of operative clinics and demonstrations which will be held in local hospitals. A return to Philadelphia for such a meeting is always a welcome announcement to those who plan to attend because of the exceptional quality of the programs which are always developed by these outstanding leaders in medicine and surgery. Headed by strong and representative committees the clinicians at the five medical schools and more than forty participating hospitals have arranged programs which will demonstrate to their guests the latest advances in surgical technique and operative procedures. A schedule of the operative clinics, demonstrations, exhibits, and other presentations to be given at the hospitals and medical schools appears in the following pages. These will be finally revised and amplified immediately preceding the Congress. Clinics will be held in the hospitals in the afternoon of Monday, October 16 and the mornings and afternoons of each of the following four days.

In addition to the extensive and well arranged schedule of operative clinics at which the technique of a wide variety of surgical procedures will be demonstrated in the operating rooms the committees have arranged a series of nonoperative clinics and symposia in many of the large hospitals for the presentation of important work being done in special fields. In many instances the local surgeons have invited prominent guests from other medical centers to participate in these discussions. There will be demonstrations and exhibits covering general surgery, genito-urinary surgery, neurosurgery, fractures and other traumas, obstetrics

and gynecology, broncho-esophagology, plastic and faciomaxillary surgery, surgery of the bones and joints, thoracic surgery, ophthalmology, and otorhinolaryngology. All of these programs are being correlated in order that the visiting surgeon may be assured of the opportunity to devote his time continuously, if he so desires, to clinics dealing with the special subject in which he may be most interested, i.e. there will be adequate morning and afternoon programs dealing with general surgery and each specialty for each day of the entire Congress. The final program will be published and classified according to the various specialties to aid the visiting surgeon in the selection of the clinics which he desires to attend. A complete detailed program will be posted each afternoon for the succeeding day in the form of Bulletins in accessible places among the technical exhibits at the headquarters hotel. They will be published in printed form for distribution each morning.

The annual meeting of the governors and fellows of the College will be held in the Rose Garden of Bellevue Stratford Hotel on Thursday afternoon at 1:30 o'clock. Reports on activities of the College will be presented by the officers and chairmen of the standing committees, followed by the election of officers.

The attention of fellows is called to the meetings of three important state and provincial committees to be held on Wednesday in the Palm Garden on the first floor of the hotel, as follows: Judiciary committees 9:30 a.m., Credentials committees 10 a.m., Executive committees 11 a.m. Also of importance is a meeting of the national and regional committees on fractures on Thursday afternoon at 4 o'clock in the South Garden.

The showing of surgical motion picture films which so faithfully depict clinical features of major interest to surgeons, will be continued at

CLINICAL CONGRESS PROGRAM IN BRIEF

All session at the Bellevue Stratford except as noted

Monday October 16

- 10 00 Hospital Conference—Rose Garden
- 11 00 Assembly of Institutes—Palm Garden
- 2 00 Clinics in Philadelphia Hospitals
- 3 00 Hospital Conference—Rose Garden
- 2 00 Surgical Film Exhibition—Palm Garden
- 8 00 Residential Meeting and Convocation—Academy of Medicine

Tuesday October 17

- 9 00 Clinics in Philadelphia Hospitals
- 9 30 Hospital Conference—Rose Garden
- 10 00 Clinical Demonstrations Ophthalmology—North Garden
- 10 00 Clinical Demonstrations Otorhinolaryngology—South Garden
- 10 00 Surgical Film Exhibition—Palm Garden
- 12 30 Midday Panel Discussions—North Garden South Garden Rose Garden Palm Garden
- 2 00 Clinics in Philadelphia Hospitals
- 2 00 Hospital Conference—Rose Garden South Garden
- 2 00 Symposium on Fractures and Other Traumas—Witherspoon Hall
- 2 00 Surgical Film Exhibition—Palm Garden
- 8 00 Scientific Session General Surgery—Irvine Hall
- 8 00 Scientific Session Ophthalmology—North Garden
- 8 00 Scientific Session Otorhinolaryngology—South Garden
- 9 00 Hospital Conference—St. Joseph's Hospital

Wednesday October 18

- 9 00 Clinics in Philadelphia Hospitals
- 9 30 Hospital Conference—Rose Garden
- 9 30 State and Provincial Judiciary Committees—Palm Garden
- 10 00 State and Provincial Credentials Committees—Palm Garden
- 11 00 State and Provincial Executive Committees—Palm Garden
- 10 00 Clinical Demonstrations Ophthalmology—North Garden
- 10 00 Clinical Demonstrations Otorhinolaryngology—South Garden

- 12 30 Midday Panel Discussions—North Garden South Garden Rose Garden Palm Garden
- 2 00 Clinics in Philadelphia Hospitals
- 2 00 Hospital Demonstrations—Philadelphia Hospitals
- 3 00 Symposium on Cancer—Rose Garden
- 2 00 Surgical Film Exhibition—Palm Garden
- 7 30 Surgical Film Exhibition (ophthalmology and otorhinolaryngology)—Palm Garden
- 8 00 Scientific Session General Surgery—Irvine Hall

Thursday October 19

- 9 00 Clinics in Philadelphia Hospitals
- 9 30 Hospital Conference—Rose Garden
- 10 00 Clinical Demonstrations Ophthalmology—North Garden
- 10 00 Clinical Demonstrations Otorhinolaryngology—South Garden
- 10 00 Surgical Film Exhibition—Palm Garden
- 1 00 Midday Panel Discussions—North Garden South Garden Palm Garden
- 1 30 Annual Meeting—Rose Garden
- 2 00 Clinics in Philadelphia Hospitals
- 2 00 Hospital Demonstrations—Philadelphia Hospitals
- 3 00 Symposium on Graduate Training—Rose Garden
- 3 30 Surgical Film Exhibition—Palm Garden
- 4 00 National and Regional Fracture Committee—South Garden
- 8 00 Scientific Session General Surgery—Irvine Hall
- 8 00 Scientific Session Ophthalmology—North Garden
- 8 00 Scientific Session Otorhinolaryngology—Rose Garden

Friday October 20

- 9 00 Clinics in Philadelphia Hospitals
- 10 00 Clinical Demonstrations Ophthalmology—North Garden
- 10 00 Clinical Demonstrations Otorhinolaryngology—South Garden
- 10 00 Surgical Film Exhibition—Palm Garden
- 12 30 Midday Panel Discussions—North Garden South Garden Rose Garden Palm Garden
- 2 00 Symposium on Obstetrics and Gynecology—North Garden
- 2 00 Symposium on Urology—South Garden
- 2 00 Symposium on Thoracic Surgery—Rose Garden
- 2 00 Clinics in Philadelphia Hospitals
- 2 00 Surgical Film Exhibition—Palm Garden
- 8 00 Meeting on Health Conservation—Irvine Hall

this year's Congress. A wide variety of special subjects will be covered in this program dealing with newer methods in technique and procedures. Of special interest to the ophthalmologists and otorhinolaryngologists will be the extensive showing of films dealing with subjects related to these specialties. These sound and silent films will be presented according to schedules announced in the daily Bulletins in the Palm Garden of the headquarters hotel.

SCIENTIFIC SESSIONS

General scientific sessions will be held on Tuesday, Wednesday and Thursday evenings in Irvine Hall at the University of Pennsylvania; the detailed programs of which will be found in the

following pages. In planning these programs the Committee has aimed at a selection of material which will make it possible for all the general surgeons and surgical specialists attending the Congress to learn of the newer developments in their respective fields. A feature of the program for Wednesday evening is the annual fracture oration to be delivered by Dr. Fraser B. Gurd of Montreal, the subject being the 'Ambulatory Treatment of Fractures of the Lower Extremities.'

Beginning on Tuesday afternoon and continuing on the three following afternoons symposia will be presented dealing with subjects of broad interest. On Tuesday afternoon the symposium will deal with fractures and other traumas includ-

ing discussions of standard operations for hip reconstruction, chest injuries, use of hanging casts for fractures of the shaft of the humerus traction treatment for fractures of the os calcis, use of sulfanilamide in gas gangrene. These subjects will be discussed by speakers who have had broad experience in the treatment of these conditions. The symposium on Wednesday afternoon will deal with the cancer problem, and on Thursday afternoon the College program for graduate training for general surgery and the surgical specialties. Three symposia will be held simultaneously on Friday afternoon, dealing with diseases of the respiratory tract, urological surgery, and obstetrics and gynecology.

The midday panel discussions introduced last year proved so popular that at this year's Congress they have been extended to include fifteen sessions, four to be held simultaneously on Tuesday, Wednesday, and Friday, and three on Thursday. Meeting places will be the North Garden, South Garden, Palm Garden and Rose Garden at the Bellevue Stratford. In addition to surgical subjects topics related to surgery, such as diet, drugs, anesthesia, infections, operating room technique and the preservation of blood for transfusions will be discussed. At each of these meetings which will necessarily be restricted by time to narrower phases of the subjects than would be covered in regular sessions a carefully selected leader will present a 10 minute outline to be followed by discussion from different viewpoints by two or more collaborators and then by general question and comment from the audience.

In the following pages are presented also programs for a series of four scientific sessions on Tuesday and Thursday evenings for the sections on ophthalmology and otorhinolaryngology. Supplementing the clinical programs in these special times prepared by the local Committee, the programs for these sessions present an exceptional variety of interesting and helpful features and discussions. Of special interest is the program for Thursday evening dealing with various phases of bronchoesophagology, presented as a tribute to Dr. Chevalier Jackson for his outstanding work in this special field.

PRESIDENTIAL MEETING AND CONVOCATION

The combined presidential meeting and convocation will be held in the Academy of Music on Monday evening opening with a processional of the officers, regents and honorary guests. Dr. Thomas A. Shallow, chairman of the Committee on Arrangements will welcome the assembly, and Dr. Vernon C. David, vice president of the Col-

lege, will introduce the foreign guests. Dr. Howard C. Naffziger, the retiring president, will deliver the presidential address, after which the incoming officers will be inaugurated, the initiates presented for fellowship fellowships and honorary fellowships will be conferred, and the medical records prize awarded. Dr. Everts A. Graham will deliver the annual oration on surgery, his subject being "Intrathoracic Tumors."

ASSEMBLY OF INITIATES

The 1939 initiates will attend an assembly on Monday morning at 11:00 o'clock in the Palm Garden of the hotel. Dr. Howard C. Naffziger, president of the College, will open the meeting with appropriate remarks. Dr. Irvin Abell, vice chairman of the Board of Regents and Dr. Bowman C. Crowell and Dr. Malcolm T. MacEachern, associate directors of the College, will briefly outline the program of the American College of Surgeons. After the initiates have recited the fellowship pledge, they will be formally greeted by Dr. George P. Muller, president elect and will sign the fellowship roll after closing remarks by Dr. George Crile, chairman of the Board of Regents.

OPHTHALMOLOGY AND OTORHINOLARYNGOLOGY

Special attention has been given through subcommittees to the development of an extensive program for the ophthalmologists and otorhinolaryngologists. Featured in the mornings will be the special clinical demonstrations to be held at the headquarters hotel on Tuesday, Wednesday, Thursday and Friday. These sessions held separately for each group will cover many of the problems of current interest to those who work in these special fields. Operative clinics and demonstrations are scheduled to be held each afternoon in the hospitals.

CLINICAL DEMONSTRATIONS—OTORHINOLARYNGOLOGY

Tuesday, 10:00 a.m.

WILLIAM HEWSON Operative Indications in Sinusitis
CARL M. HOESER Topic to be announced
HENRY A. MILLER Treatment of Sinusitis in Children
THOMAS F. COWEN Management of Nasopharyngeal Fibromata

Wednesday, 10:00 a.m.

ROBERT H. IVY Pathological Conditions of the Mouth
GABRIEL TUCKER Diagnosis and Treatment of Laryngeal Tumors Benign and Malignant (color motion picture)
CHEVALIER L. JACKSON Bronchoscopic Aspects of Bronchial and Pulmonary Tumors
LOUIS CLIFF Pathological Conditions of the Esophagus

Thursday, 10:00 a.m.

Symposium on Chronic Progressive Deafness
OSCAR A. BATSON Anatomy and Physiology of the Ear

- HARRY P. SCHENCK Thyroid in the Treatment of Deafness and Tinnitus
 WALTER H. HUGHSON Surgical Treatment (round window graft)
 EDWARD H. CAMPBELL Surgical Treatment (thyroid fistulization)

Friday 10:00 a.m.

- F. HAROLD KRATZ Diagnosis of Lateral Sinus Thrombosis (report of cases)
 HOWARD M. HEDBELL Treatment of Otitis Media and Mastoiditis of Infants and Children with Sulfanilamide
 HARRISON F. FLIPPIN Treatment of Pneumococcus Meningitis with Sulfapyridine

OPHTHALMOLOGY

The day 10:00 a.m.

- F. H. ADLER Dark Adaptation

Wednesday 10:00 a.m.

- W. I. LILLIE Fundus Changes Associated with Neurosurgical Conditions

Thursday 10:00 a.m.

- F. B. SPATH Subject to be announced

Friday 10:00 a.m.

- I. S. TABMAN The Conduct and Methods of a Refraction Department in a Large Hospital

GRADUATE TRAINING FOR SURGERY

Following the annual meeting of the fellows on Thursday afternoon there will be a conference on Graduate Training for Surgery at 3:00 p.m. which promises to be of major interest to every one attending the Clinical Congress. Raising the standards of surgery has been the primary purpose of the American College of Surgeons since its organization and the direct action which has now been taken in sponsoring the present program of guidance and service for approved hospitals desirous of developing or improving their facilities for graduate training in surgery has stimulated wide interest in this subject.

The committee charged with the development of this program authorized the field staff of the College to begin personal surveys of hospitals and study of their problems in January, 1937. Interested institutions throughout the United States and Canada have been visited during the past three years and the list of hospitals approved for graduate training in surgery and the surgical specialties has been published in the 1939 BULLETIN of the College together with outlines of the plans and educational programs of a representative group of hospitals.

A vast amount of information and data have been assembled at the College which will form the basis for the report of the Committee on Graduate Training for Surgery to be presented by its chairman Dr. Dallas B. Phemister of Chicago at this session.

Leaders in the field of graduate medical education will present and discuss at length the various problems to be met in a hospital desiring to train young surgeons according to the present concept of required qualifications for fellowship in the College. The discussion will deal with all phases of organization and supervision of the educational programs: basic science requirements, records, reports and examinations necessary in the proper evaluation of graduate training in hospitals and other institutions. This session should be of great importance to the entire fellowship of the College as many practical suggestions will be offered which will be of great value to those charged with the responsibility of developing in hospitals the needed systematic supervision, preceptorship and guided instruction so essential in the training of surgeons.

HOSPITAL CONFERENCE

The twenty-second annual Hospital Standardization Conference during the Clinical Congress in Philadelphia, October 16 to 20, inclusive will provide an opportunity for the thorough discussion of many problems incident to the institutional care of the patient which are of vital interest to members of medical staffs of hospitals, trustees, administrators and other executive personnel. During the four-day conference carefully selected speakers from various fields of hospital work will participate in the program. Addresses, panel discussions, round table conferences and practical demonstrations will characterize the conference and all the participants will present well selected and prepared subject matter.

The conference will open at 10:00 a.m. on Monday, October 16 in the Rose Garden of the Bellevue Stratford Hotel. Following an address by Dr. Howard C. Naffziger, San Francisco, president of the College, Dr. George C. Cleland, Cleveland, chairman of the Board of Regents of the College, will officially present the list of approved hospitals for 1939. Five discussions of major interest will then follow—two on graduate training for general surgery and the surgical specialties and three by presidents of national hospital organizations on (1) voluntary hospitals and their preservation, (2) essential qualifications of a competent hospital administrator and (3) the need for educated and trained personnel in caring for the sick. The discussion of these subjects will be opened by Dr. George F. Muller, Philadelphia, president elect of the College.

At two other sessions—on Monday afternoon and on Thursday morning—a variety of important topics will be discussed. The Monday after

noon session will include opening remarks on hospital standardization in Canada by Dr Fraser B. Gurd, vice president of the College, followed by discussions on (1) the relation of nursing hours to various types of diseases (2) the relation of diet therapy and more particularly vitamins, to the surgical patient (3) the responsibility of the hospital trustee, (4) research and statistics as applicable to hospitals and (5) nursing service in relation to administrative activities of the hospital. The Thursday morning session will be equally interesting and include discussion of radio interference caused by electromedical and surgical equipment organization and operation of a tumor unit and three talks on principles of relationship between hospitals and radiologists, pathologists, and anesthesiologists respectively. Both sessions will be held in the Rose Garden.

Tuesday morning's session will be given over to a discussion on 'The Medical Staff, Its Organization and Function,' commencing at 10:00 a.m. in the Rose Garden. Following the presentation of the subject 'The Importance of an Efficient Medical Staff to a Hospital,' four speakers will discuss the general theme of the session from the standpoints of what actually constitutes a medical staff, proper procedures in extending hospital privileges, and making appointments to the medical staff, selection and appointment of chief of medical staff and heads of clinical departments. The session will be concluded by a presentation and discussion on controlling the clinical work through accounting of professional services.

A panel round table conference of special interest on the general theme, 'The Organization and Management of the Small Hospital,' will be held on Tuesday afternoon in the South Garden. Participants in this program will discuss the general theme from the standpoints of the importance of the small hospital in certain communities, maintaining competent personnel, medical staff organization, medical records, clinical laboratory and x-ray services, nursing, and financing. Special emphasis will be laid on the importance of all small hospitals meeting the minimum requirements. At the same time in the North Garden there will be held panel discussions on problems pertaining to various phases of hospital administration in the large hospital. Related topics to be discussed include administrative practices, accounting control and hospital costs, anesthesia care of emergencies, control of postoperative infections from the standpoint of surgical instruments, hospitalization and compensation charges. These topics should appeal to a variety of interests. The session will be under the direction

of Dr Wilmar M. Allen, Hartford, Conn., superintendent of the Hartford Hospital.

On Tuesday evening the auditorium of St. Joseph's Hospital will accommodate the large audience which is expected to attend a round table conference at which pertinent problems, submitted by hospital executives will be presented and discussed under the leadership of Robert Jolly, Houston, Texas, and Dr. Malcolm T. MacEachern, Chicago. Opportunity will be given everyone present to submit their specific problems for discussion.

The joint conference of the American College of Surgeons and the American Association of Medical Record Librarians will be held in the Rose Garden, Wednesday morning under the chairmanship of Dr. Robin C. Buerki, Chicago. The session will be opened by a review of the present status of medical records in the United States and Canada by Dr. E. W. Williamson, assistant director of the American College of Surgeons. Following this the president of the Association, Lillian H. Erickson, Chicago, will discuss 'The Present Status of the Training of Medical Record Librarians.' Other subjects on this program will include 'Overcoming Difficulties in Obtaining Good Medical Records in a Small Hospital.'

'The Place of the Medical Secretary in the Hospital,' 'Systematic Procedure Necessary in Keeping Current Medical Records Up to Date,' and 'How to Secure Specialty Medical Records.' These presentations will be followed by a round table conference on 'Medical Record Problems' to be conducted by Dr. W. F. Wood, Waverly, Mass.

A unique feature of the four day program will be the demonstrations in local hospitals on Wednesday and Thursday afternoons. These will include a wide variety of administrative and technical procedures which will be of utmost interest and practical value to general and specialized hospital personnel. The demonstrations will include many new and interesting features now of proved value.

Ample opportunity for informal discussion will be given at all of the sessions of the conference. Exhibits and motion pictures of interest to hospital people will provide additional educational possibilities. Governing boards of hospitals will find their institutions well repaid in added incentive and knowledge by permitting members of their medical staffs and administrative organization to take advantage of the discussions at this conference. A most cordial invitation is extended to every hospital to be represented at this hospital conference.

ADVANCE REGISTRATION

The hospitals and medical schools of the Philadelphia area afford accommodations for large numbers of visiting surgeons but to insure against overcrowding attendance at the Congress will be limited to the number that can be comfortably accommodated at the clinics. The limit of attendance will be based upon the results of a survey of the operating rooms and laboratories of the hospitals and medical schools to determine their capacity for visitors. It is expected therefore that those surgeons who wish to attend the Congress will register in advance. A registration fee will be required in order to provide funds with which to meet the expenses of the Congress. A formal receipt will be issued to each surgeon registering in advance which is to be exchanged for a general admission card upon his registration at headquarters during the Congress. This card which is not transferable must be presented to secure clinic tickets and admission to scientific sessions.

A resolution adopted by the Board of Regents provides that the registration fee for fellows and endorsed junior candidates shall be \$5.00 that no fee for the 1939 Congress shall be required of initiates (class of 1939) that the fee for non-fellows attending as invited guests of the College will be \$10.00.

As in previous years admission to clinics and demonstrations at the hospitals will be controlled by means of clinic tickets which plan provides an efficient means for the distribution of visiting surgeons at the various clinics and assures against overcrowding. The number of tickets issued for any clinic will be limited to the capacity of the room in which the presentation is held.

HEADQUARTERS—TECHNICAL EXHIBITION

Headquarters for the Congress will be established at the Bellevue Stratford Hotel where there are unusual facilities for accommodating the Congress. The Ballroom, Palm Garden, Clover and Red rooms and other large rooms on the first and second floors and the roof have been reserved for scientific exhibits and conferences, registration clinic ticket bureaus, bulletin boards, executive offices, etc. Thus the activities of the Congress will be centralized under one roof.

The Technical Exhibition will be located in the Ballroom and adjacent rooms on the second floor. The registration and clinic ticket bureaus together with the registration desk will be centrally located on that floor. The bulletin boards on which the daily clinical programs will be posted each afternoon will be distributed through the exhibit rooms. Leading manufacturers of surgical

COMMITTEE ON ARRANGEMENTS

EXECUTIVE COMMITTEE

Thomas A. Shallow	Robert H. Ivy
Chairman	Chevalier L. Jackson
Lewis K. Ferguson	Richard H. Meade
Secretary	Thaddeus L. Montgomery
William Bates	J. T. Nicholson
W. E. Burnett	John Paul North
Edward I. Campbell	Hubley R. Owen
J. Montgomery Deaver	Franklin L. Payne
Everett H. Dickinson	Warren S. Reese
Gilson C. Engel	Frederick R. Robbins
Theodore R. Fetter	Thomas J. Ryan
Kenneth L. Fry	Calvin M. Smyth, Jr.
Ralph Goldsmith	Margaret Sturgis
Francis Crant	

SUB COMMITTEES

Broncho-esophagology—Chevalier L. Jackson	Chairman
General Surgery—Hubley R. Owen	Chairman
Genito-Urinary Surgery—Theodore R. Fetter	Chairman
Alexander Randall	
Industrial Surgery—William Bates	Chairman
Neuro Surgery—Francis Crant	Chairman
Gynecology and Obstetrics—Franklin L. Payne	Chairman
Norris W. Vauz	Thaddeus L. Montgomery
Ophthalmology—Warren S. Reese	Chairman
Orthopedic Surgery—J. T. Nicholson	Chairman
Otorhinolaryngology—Edward L. Campbell	Chairman
Plastic Surgery—Robert H. Ivy	Chairman
Publicity—Kenneth L. Fry	Chairman
Deaver Richard H. Meade	
Thoracic Surgery—W. Emory Burnett	Chairman

instruments and supplies, x-ray equipment, operating room lights, hospital apparatus of all kinds, ligatures, dressings, pharmaceuticals and publishers of medical books will be represented.

PHILADELPHIA HOTELS AND THEIR RATES

In addition to the headquarters hotel, the Bellevue Stratford, there are many first class hotels within a short walking distance providing ample hotel facilities at reasonable rates. It is suggested that reservation of hotel accommodations be made at an early date at the following hotels which are recommended by the committee:

	S	gl	th	bt	fr
Adelphi 13th and Chestnut Sts	\$3.85	\$5.50			
Barclay Rittenhouse Square E	4.50	7.00			
Bellevue Stratford Broad and Walnut Sts	3.85	5.50			
Benjamin Franklin 9th and Chestnut Sts	3.85	5.50			
Colonial 11th and Spruce Sts	2.50	3.50			
Drake 1512 Spruce St	4.00	6.00			
Majestic Broad St and Girard Ave	2.50	4.00			
Philadelphia 30th and Chestnut Sts	2.75	4.50			
Ritz Carlton Broad and Walnut Sts	3.50	6.00			
Robert Morris 17th and Arch Sts	2.50	3.50			
Spruce 13th and Spruce Sts	1.50	2.50			
St. James 13th and Walnut Sts	2.75	4.50			
Sylvania Juniper and Locust Sts	3.00	5.00			
Walton Broad and Locust Sts	2.50	4.00			
Warwick 17th and Locust Sts	4.50	7.00			
Wellington 19th and Walnut Sts	4.00	6.00			

PROGRAM FOR EVENING SESSIONS

Presidential Meeting and Comotation—Monday 8 00 p m —Academy of Music

Processional—Officers Regents and Honorary Guests

Invocation

Address of Welcome THOMAS A SHALLOW M D Philadelphia Chairman Committee on Arrangements

Introduction of Foreign Guests VERNON C DAVID M D Chicago Vice President

Address of Retiring President HOWARD C NAFFZIGER M D San Francisco

Inauguration of Officers

President GEORGE P MULLER M D Philadelphia

First Vice President HENRY W CAVE M D New York

Second Vice President D EDWIN ROBERTSON M D Toronto

Presentation of Initiates for Fellowship GEORGE CRILE M D Cleveland Chairman Board of Regents

Conferring of Fellowships by the President GEORGE P MULLER M D Philadelphia

Conferring of Honorary Fellowships The President

Medical Records Prize Award

Annual Oration on Surgery Intrathoracic Tumors EVARTS A GRAHAM M D St Louis

Tuesday 8 00 p m —Irvine Hall

The Essential Principles in Clean Wound Healing ALLEN O WHIPPLE M D New York

Control of Hemorrhagic Tendencies Including Physiology and Chemistry WALTMAN WALTERS M D
Rochester MinnWater and Salt Requirements in the Postoperative Case FREDERICK A COLLIER M D Ann Arbor Mich
Vitamin and Protein Factors in the Pre operative and Postoperative Care of Surgical Patients EMILE
HOLMAN M D San Francisco*Wednesday 8 00 p m —Irvine Hall*

Decompression in the Treatment of Intestinal Obstruction D EDWIN ROBERTSON M D Toronto

Management of Chronic Pelvic Infections GEORGE H GARDNER M D Chicago

Conservative Surgery of Bone Tumors DALLAS B PHEMISTER M D Chicago

Fracture Oration The Ambulatory Treatment of Fractures of the Lower Extremity FRASER B GURD
M D Montreal*Thursday 8 00 p m —Irvine Hall*

The Re establishment of the Gastric Passage after Resection PROF DR JENO POLYA Budapest Hungary

Duplications of the Alimentary Tract WILLIAM E LADD M D Boston

Evaluation of Current Methods in the Management of Peptic Ulcer VERNE C HUNT M D Los Angeles

Operability and Factors which Increase Curability of Malignancy of the Colon and Rectum THOMAS E
JONES M D Cleveland

OPHTHALMOLOGY

Tuesday 8 00 p m —North Garden Bellevue Strayford Hotel

Symposium Surgical Aspect of Detachment of the Retina

Results of Operations for Detachment of the Retina at the Mayo Clinic WILLIAM L BENEDICT M D,
Rochester MinnResults of Operations for Detachment of the Retina at the New York Eye and Ear Infirmary CONRAD
BERENS M D, New YorkResults of Operations for Detachment of the Retina at the Memphis Eye Ear Nose and Throat Hospital
EDWARD C ELLETT M D Memphis TennResults of Operations for Detachment of the Retina at the Illinois Eye and Ear Infirmary SAMUEL J
MEYER M D ChicagoResults of Operations for Detachment of the Retina at the Washington University School of Medicine
LAWRENCE T POST M D and THEODORE E SANGERS M D St Louis

General Discussion

Thursday, 8:00 p.m. — North Garden Bellevue Stratford Hotel

Recent Advances in Plastic Surgery about the Eyes (Technique) ALFRED I. BLAIR M.D. St. Louis
The Technique of Correction of Blepharoptosis DANIEL B. KERRY M.D. New York
General Discussion

OTORHINOLARYNGOLOGY

Tuesday, 8:00 p.m. — South Garden Bellevue Stratford Hotel

Symposium Evaluation of Methods of Treatment in Sinusitis

The Indications for Surgical Treatment in Sinusitis FREDERICK T. HILL M.D. Waterville, Maine
The Treatment of Accessory Sinus Infections in Young Children EDWARD A. LOOPER M.D. Baltimore
General Discussion

Thursday, 8:00 p.m. — Rose Garden Bellevue Stratford Hotel

CHEVALIER JACKSON M.D. Philadelphia, Honor Guest

GEORGE P. MULLER M.D. Philadelphia, President, American College of Surgeons, Presiding

Introductory Remarks GEORGE P. MULLER M.D. Philadelphia

Response CHEVALIER JACKSON M.D. Philadelphia

Present Trend in the Technique of Laryngectomy CHEVALIER JACKSON M.D. Philadelphia

Foreign Bodies in the Air and Food Passages (Observations on End Results in a Series of Nine Hundred Fifty Cases) LOUIS H. CLIFF M.D. Philadelphia

Laryngofissure after the Technique of Chevalier Jackson (Observations on Technique and Results in a Series of Over One Hundred Cases) GABRIEL TUCKER M.D. Philadelphia

The Development of Bronchoesophagology CHARLES J. IMPERATORI M.D. New York

The Voice after Laryngeal Operations CHEVALIER L. JACKSON M.D. Philadelphia

PROGRAM FOR AFTERNOON SESSIONS

SYMPOSIUM ON FRACTURES AND OTHER TRAUMAS

Tuesday, 2:00 p.m. — Witherspoon Hall

ROBERT H. KENNEDY M.D. New York, Chairman, Committee on Fractures and Other Traumas, Presiding
An Impartial Evaluation of Several Standard Operations for Hip Reconstruction OTTO J. HERMAN M.D. Boston

Chest Injuries FRANK B. BERRY M.D. New York

The Use of Hanging Casts for Fractures of the Shaft of the Humerus JOHN A. CALDWELL M.D. Cincinnati

Evaluation of the Traction Treatment of Fractures of the Olecranon JOHN DUNLOP M.D. Pasadena
Primary and Secondary Tendon Suture MICHAEL L. MASON M.D. Chicago

SYMPOSIUM ON CANCER

Wednesday, 2:00 p.m. — Rose Garden Bellevue Stratford Hotel

FRANK E. ADAIR M.D. New York, Chairman, Cancer Committee, Presiding

Radiological Treatment of Cancer of Tongue HAYES E. MARTIN M.D. New York

Surgical Treatment of Cancer of Tongue LELAND R. COWAN M.D. Salt Lake City

Treatment of Cancer of the Esophagus WILLIAM F. KIENHOFF JR. M.D. Baltimore

What Constitutes Malignant Tumors of the Nervous System ERNEST SACHS M.D. St. Louis

Cancer Clinics BOWMAN C. CROWELL M.D. Chicago

Survival Statistics Cancer of the Breast 1925-1935 (Jefferson Hospital) WILLIAM H. KRAEMER M.D. Philadelphia

SYMPOSIUM ON GRADUATE TRAINING FOR SURGERY

Thursday, 3 00 p m — Rose Garden Bellevue Stratford Hotel

DALLAS B. PHEMISTER, M.D., Chicago, Chairman, Committee on Graduate Training for Surgery. Presiding
Organizing an Educational Program WILLIS D. GATCH, M.D., Indianapolis

Discussion led by GEORGE J. HEUER, M.D., New York

Supervision of the Educational Program WALTER WALTERS, M.D., Rochester, Minn.

Basic Science Requirement.

Basic Course WALTER ESTELL LEE, M.D., Philadelphia

Research ALEXANDER BRUNSCHWIG, M.D., Chicago

Organized Study of Surgical Pathology

Evaluation of Graduate Training—Records, Reports, and Estimates of Work

WALTER D. WISE, M.D., and HENRY F. BONGARDT, M.D., Baltimore

General Discussion HOWARD C. NAFFZIGER, M.D., San Francisco, ALTON OCHSNER, M.D., New Orleans,

DONALD GUTHRIE, M.D., Sayre, Pa.

SYMPOSIUM ON THE SURGICAL TREATMENT OF DISEASES
OF THE RESPIRATORY TRACT*Friday, 2 00 p m — Rose Garden, Bellevue Stratford Hotel*

Principles in the Treatment of Empyema WILLARD VAN HAZEL, M.D., Chicago

Relationship of Bronchoscopy to Surgery of the Respiratory Tract JOHN D. KERVIN, M.D., New York

Surgical Treatment of Pulmonary Abscess GEORGE J. HEUER, M.D., New York

Curability of Primary Carcinoma of the Lung Early Recognition and Management RICHARD H. OVERHOLT, M.D., Boston

Postoperative Pulmonary Complications DANIEL C. ELKIN, M.D., Atlanta

SYMPOSIUM ON OBSTETRICS AND GYNECOLOGY

Friday, 2 00 p m — North Garden, Bellevue Stratford Hotel

Some Complications of Pregnancy in which Cesarean Sections Is Indicated ARTHUR H. BILL, M.D., Cleveland

The Management of Dystocias of Pregnancy ALFRED C. BECK, M.D., Brooklyn

Foxemias of Pregnancy HERMAN W. JOHNSON, M.D., Houston, Texas

Prophylaxis and Treatment of Carcinoma of the Cervix and Body of the Uterus WILLARD R. COOKE, M.D., Galveston, Texas

Endocrine Therapy in Obstetrics and Gynecology JOHN C. BURCH, M.D., Nashville, Tenn.

SYMPOSIUM ON UROLOGY

Friday, 2 00 p m — South Garden, Bellevue Stratford Hotel

End Results in Carcinoma of the Bladder Treated by Radium BENJAMIN S. BARRINGER, M.D., New York

Urologic Aspects of Hypertension DAVID W. MACKENZIE, M.D., Montreal

Perirenal Infections HOMER G. HAMER, M.D., Indianapolis

Some Complications and Dangers of the Lower Ureteral Calculus JOHN K. ORMOND, M.D., Detroit

The Development of Prostatic Hyperplasias CLYDE L. DENING, M.D., New Haven

MIDDAY PANEL DISCUSSIONS

Tuesday 12:30 to 1:45 p.m. — Bellevue Stratford

Rose Garden

Delayed Union and Non Union of Fractures
ROBERT H. KENNEDY M.D. New York 1 residing

South Garden

Brain Abscess CHARLES BAGLEY JR. M.D. Baltimore Presiding

Palm Garden

Sterilization and Aseptic Operating Room Technique
ELLIOT C. CUTLER M.D. Boston Presiding

North Garden

Pre and Postoperative Drugs Used in Gastrointestinal Surgery
IRVING MIMS (AGE) M.D. New Orleans 1 residing

Wednesday 12:30 to 1:45 p.m. — Bellevue Stratford

Rose Garden

Biliary Tract Surgery and the Bad Risk Case
ARTHUR W. ALLEN M.D. Boston Presiding

South Garden

Treatment of Varicose Veins
H. O. MCPHEETERS M.D. Minneapolis Presiding

North Garden

Vitamins and Surgery
CHARLES B. LUESTOW M.D. Chicago 1 residing

Palm Garden

Factors Preventing Ammonia Formation in Preserved Blood
JOHN SCHLÖDER M.D. New York 1 residing

Thursday 1:00 M to 1:15 p.m. — Bellevue Stratford

North Garden

Ulcerative Colitis
HENRY W. CAVE M.D. New York 1 residing

South Garden

The Recognition and Management of Hyperthyroidism
GEORGE M. CURTIS M.D. Columbus Ohio Presiding

Palm Garden

Postoperative Wound Disruption—Methods of Closure
ARTHUR M. SHIPLEY M.D. Baltimore Presiding

Friday 12:30 to 1:45 p.m. — Bellevue Stratford

Rose Garden

Analgesia and Anesthesia in Obstetrics
HOWARD F. KANE M.D. Washington Presiding

Palm Garden

Postoperative Infections
FRANK L. MELENEY M.D. New York Presiding

North Garden

The Management of Cleft Lip and Cleft Palate
GEORGE WARREN PIERCE M.D. San Francisco Presiding

South Garden

Indications for Surgical Treatment of Renal Tuberculosis
GILBERT J. THOMAS M.D. Minneapolis Presiding

ASSEMBLY OF INITIATES

Monday 11:00 a.m. — Palm Garden, Bellevue Stratford Hotel

Opening Remark
HOWARD C. NAFFZIGER M.D. San Francisco President

The Program of the American College of Surgeons

IRVIN ABELL M.D. Louisville Vice Chairman Board of Regents

BOWMAN C. CROWELL M.D. Chicago Associate Director

MALCOLM T. MACFARLAIN M.D. Chicago Associate Director

The Fellowship Pledge Recital by Initiates

Greetings to the Initiates
GEORGE F. MULLER M.D. Philadelphia President elect

Closing Remarks
GEORGE CRILE M.D. Cleveland Chairman Board of Regents

Signing of the Fellowship Roll The Initiates

ANNUAL HOSPITAL STANDARDIZATION CONFERENCE

Monday 10 00—Rose Garden, Bellevue Stratford Hotel

HOWARD C. NAFZIGER M.D. San Francisco, President
American College of Surgeons presiding
Address of President—The Hospital Program of the American College of Surgeons

The 1939 Hospital Standardization Survey—Official Announcement of the List of Approved Hospitals GEORGE CRILE M.D. Cleveland Chairman Board of Regents American College of Surgeons

Present Trends in Graduate Training for Surgery DALLAS B. PHEMISTER M.D. Chicago

The Preservation of our Present Voluntary Hospital System REV. A. M. SCHWITALLA S.J. St. Louis

Educated and Trained Personnel Essential for Maintaining Proper Standards of Service in the Care of the Hospitalized Patient FRED G. CARTER M.D. Cleveland

The Role of the Hospital in Graduate Education for the Physician or Surgeon Desirous of Proper Preparation for his Specialty ROBIN C. BUEHLER M.D. Chicago

Essential Qualifications of an Efficient Hospital Administrator JAMES A. HAMILTON New Haven Conn.

General Discussion Opened by GEORGE F. MULLER M.D. Philadelphia

Monday 2 00—Rose Garden, Bellevue Stratford Hotel

FRASER B. GURD M.D. Montreal Vice President American College of Surgeons presiding

Opening Remarks—Hospital Standardization in Canada FRASER B. GURD M.D. Montreal

A Study of Nursing Hours in the Care of Various Types of Patients ALBERT H. SCHULTZ Chicago

Relation of Dietary Deficiencies to Surgical Convalescence CHARLES B. PUKSTON M.D. Chicago

The Hospital Trustee and His Proper Conception of Administrative and Professional Practices RAYMOND P. SLOAN New York

The Significance of Trends and Statistics in the Hospital Field ARNOLD F. TUCH PH.D. Chicago

Criteria for an Efficient Graduate Nursing Service with Special Reference to Administrative Policies of the Hospital ALMA H. SCOTT R.N. New York

General Discussion Opened by LEWIS E. JARRETT M.D. Richmond Va.

Tuesday 10 00—Rose Garden, Bellevue Stratford Hotel

CLAUDE W. MUNGER M.D. New York presiding
General Theme The Medical Staff Its Organization and Function

The Importance of an Efficient Medical Staff to a Hospital HARVEY AGNEW M.D. Toronto

Discussion from the standpoints of
What Constitutes a Medical Staff? OSWALD V. ANDERSON M.D. St. Louis

The Right of the Governing Board of the Hospital to Appoint the Medical Staff JOSEPH C. DOANE M.D. Philadelphia

Proper Procedure to Follow When Extending Hospital Privileges and Making Appointments to the Medical Staff CHARLES H. YOUNG M.D. Montclair N.J.

Selection and Appointment of Chief of Staff and Heads of Departments JESSIE J. TURNBELL R.N. Pittsburgh

Accounting of Professional Services as a Means of Controlling Clinical Work THOMAS R. PONTIOT M.D. Chicago

General Discussion Opened by JOE R. CLEMONS M.D. New York

Tuesday 2 00—South Garden, Bellevue Stratford Hotel

Panel Round Table Discussion General Theme The Organization and Management of the Small Hospital Conducted by ROBERT JOLLY Houston Texas

The Importance of the Small Hospital in Certain Communities CHARLES A. LINDQUIST Elgin Ill.

Discussion from the following viewpoints
Personnel Securing adequate personnel minimizing turnover maintaining good morale training hospital personnel MILDRED WALKER Wauson Ohio

Medical Staff Organization Selecting and organizing the medical staff controlling the clinical work conducting medical staff conferences HUSTON L. SPANGLER M.D. Chicago

Medical Records Securing medical records filing and preserving medical records using medical records JAMES H. SPEYER JR. M.D. Franklin N.J.

Clinical Laboratory Service Providing adequate service maintaining competent technical services supervision and financing the clinical laboratory LALL G. MONTGOMERY M.D. Muncie Ind.

X-ray Service Providing adequate service maintaining competent technical services supervising and financing the x-ray department DAVID M. CALDWELL M.D. Manchester Conn.

Nursing Service Providing adequate service supplementing nursing service with attendants or subsidiary workers determining personnel requirements maintaining permanency in personnel EDNA D. PRICE R.N. Concord, Mass.

Financing Assuring accounting efficiency utilizing all sources of revenue collecting delinquent accounts stimulating philanthropic endeavor O. K. FIKE Richmond Va.

Tuesday 00—Rose Garden, Bellevue Stratford Hotel

Panel Round Table Discussion Problems Pertaining to Various Phases of Hospital Administration in the Large Hospital Conducted by WILMAR M. ALLEN M.D. Hartford Conn.

Administration Maintaining good morale among hospital personnel admitting and discharging procedure, responsibility for scientific work conferences of administrator with heads of departments J. C. MAC KENZIE M.D. Montreal

Accounting Control and Hospital Costs Budget—pre-determined costs control of purchases personnel day by day control issuance of food medical supplies etc. total costs functional costs per capita costs (in and out patients) GORDON T. BROAD New York

Anesthesia Essentials of a properly organized department, responsibility for selection of type of anesthetic to be used pre-anesthetic examination of patient elimination of anesthetic hazards MILTON C. PETERSON M.D. New York

Emergencies Organization of emergency services shock hemorrhage and poisoning blood transfusion emergency lighting in the hospital JOHN M. T. FINNEY JR. M.D. Baltimore

Control of Postoperative Infections from the Standpoint of Surgical Instruments Unsterilized versus sterilized instruments technique for cleansing and sterilizing surgical instruments decreased inventory of surgical instruments labor saving and other factors in post-operative infections CARL W. WALTER M.D. Boston

Hospitalization and Compensation Charges For hospitalization patients for compensation or insurance

patients uniform charges co operative action among hospitals NORA I YOUNG R.N. Brooklyn

Tuesday 8 00 p m—St Joseph's Hospital

Round Table Conference—Presentation and Discussion of Pertinent Hospital Problems Submitted by Hospital Executives Conducted by ROBERT JOLLY Houston Texas and MALCOLM T. MACLEACH R.N. Chicago

Wednesday 9 30—Rose Garden Bellevue Stratford Hotel

Joint Conference with American Association of Medical Record Librarians ROBERT C. BILBERT M.D. Chicago presiding

Review of the Present Status of Medical Records in the United States and Canada as seen by the American College of Surgeons EARL W. WILLIAMSON M.D. Chicago

The Present Status of the Training of Medical Records Librarians WILLIAM H. FRICKON R.R.I. Chicago

Difficulties in Securing Good Medical Records in the Small Hospital and What We Have Done to Overcome Them CENNIVIS HILKER R.R.I. Decatur Iowa

The Place of the Medical Secretary in the Hospital RUTH HARRIS R.R.I. Bluefield W. Va.

Overcoming Problems Incident to Securing Acceptable Specialty Medical Records RAY K. DALL M.D. Houston Texas

Round Table Conference—Medical Records Problems Conducted by W. FRANKLIN WOOD M.D. Waverley Mass

Wednesday 4 00—Demonstrations in Local Hospitals

Children's Hospital SIBBON C. FRANCIS R.N. Superintendent

Pediatric Nursing Care and Isolation Precautions

Infantile Eczema DONALD M. PILLSBURY M.D.

Children in Chapple Cabinet Cabinets CHARLES C. CHAPPLE M.D.

Administration of Blood Transfusions to Infants ALICE C. MCGINNIS M.D.

Procedure and Technique in Making Up Infant Feedings—Milk Laboratory AGNES H. ADAMS and ARLENE SALES

Graduate Hospital of the University of Pennsylvania DONALD C. SMELZER M.D. Director

Organization and Management of a Blood Bank FRANK JONES M.D. MELBA LEBBACH and MARGUERITE LUKENS

Central Solution Room ALEXANDER KELLER and MARGARET HIFFER

Technique of Preparation and Administration of Parenteral Solutions FRANK JONES M.D. and JOSEPHINE LAMBROTH

Hospital of the University of Pennsylvania MARY V. STEPHENSON Superintendent

Central dressing room pediatric bedside clinic (nursing techniques) use of the outpatient department in teaching the student nurse resuscitation and oxygen therapy from the physician's and nurse's viewpoint the nurse's responsibility in Wason's suction drainage blood transfusions and venoclysis demonstration of vasodilator bed

Lankenau Hospital ROBERT SHOEMAKER M.D. Executive Medical Officer

Organization and Management of Medical Records Department GILSON C. LACROIX M.D. and staff

Follow up and Study of End Results STANLEY P. REIMANN M.D. and staff

United States Naval Hospital Captain HENRY L. DOLAN M.D. Commanding Officer

Physical Therapy Lieutenant CARL K. YOUNG M.D.

Jefferson Medical College Hospital ROBERT B. NYE M.D. Medical Director

Organization management and clinic methods—Curtis Clinic Motion picture technique ROBERT B. NYE M.D. and HARVARD R. HANRECK M.D.

Thursday 9 30—Rose Garden Bellevue Stratford Hotel

DONALD C. SMELZER M.D. Philadelphia presiding

Interference with Radio Reception Caused by Electro-Medical Equipment H. B. WILLIAMS M.D. New York

Organization and Operating Problems of a Tumor Unit in a General Hospital JOSEPH TENOPFER M.D. Brooklyn

Principles of Relationship Between Radiologists and Hospitals B. R. KIRKLIN M.D. Rochester Minn.

Principles of Relationship Between Pathologists and Hospitals FRANK HARTMAN M.D. Detroit

Principles of Relationship Between Anesthetists and Hospitals LEMMA A. ROVENSTINE M.D. New York

General Discussion Opened by BASIL C. MACLEAN M.D. Rochester N.Y.

Thursday 4 00—Demonstrations in Local Hospitals

Pennsylvania Hospital (Woman's Building) NORRIS W. VALEY M.D. Obstetrician and Gynecologist in Chief

Maternal Care Obstetrical Technique and Procedure Admission of Patient and Arrangement to Accommodation SPOT-WOOD ROBERTS M.D.

Prenatal Care J. VERNON ELLISON M.D.

Special Clinics CRAIG WRIGHT MCKEE M.D.

Preparation of Patient ROBERT M. SHIRREY M.D.

Observation of Patient in Labor POSS B. WILSON M.D.

Delivery Room Set up Obstetrical Technique and Procedure CLIFFORD B. LULL M.D.

Care of the Patient Immediately Postpartum JOHN C. ULLERY M.D.

Care of the Patient Through Puerperium While in the Hospital ROBERT A. KIMBROUGH M.D.

Follow up and End Results F. SIDNEY DENNE M.D.

Out Patient Clinic PENDELTON TOMPKINS M.D.

Care of the Newborn RALPH M. TYSON M.D.

Pennsylvania Hospital JOHN N. HATFIELD Administrator

Food Service MARGARET J. BESETT

Philadelphia General Hospital WILLIAM C. TURNBULL M.D. Superintendent

Organization and Management of a Blood Bank I. S. HNELESKI M.D.

Nursing Technique LORETTA M. JOHNSON R.N.

Wills Hospital STEPHEN WIERZBICKI Superintendent

Development of Consultation Clinics in Specialty Hospitals JOSEPH A. KLAUDER M.D. and WILLIAM FRANCIS WHELAN M.D.

Nursing and Operating Room Technique in an Eye Hospital GLADYS L. COLE and HILDA R. MILLER

PRELIMINARY CLINICAL PROGRAM

ARRANGED IN THE FOLLOWING SUBDIVISIONS: GENERAL SURGERY, OBSTETRICS AND GYNECOLOGY, SURGERY OF BONES AND JOINTS, GENITO URINARY SURGERY, FRACTURES AND OTHER TRAUMAS, NEUROSURGERY, THORACIC SURGERY, PLASTIC AND FACIO-MAXILLARY SURGERY, BRONCHO ESOPHAGIOLOGY, OTORHINOLARYNGOLOGY, OPHTHALMOLOGY

GENERAL SURGERY

Monday

HOSPITAL FOR DISEASES OF STOMACH

FRANCIS A. MANTZ—1 Operative and dry clinic

JEFFERSON HOSPITAL

ROBERT LAYTON and SHERMAN FLOR—11 Varicose veins
J. HALL ALLEN and BENJAMIN HASKELL—13 Lesions of the anus and rectum
HENRY K. MOELLER—2 Therapeutics in surgery

MOUNT SINAI HOSPITAL

MOSES BRENNER and staff—115 Operations

PENNSYLVANIA HOSPITAL

ORVILLE C. KING—Spinal anesthesia
GARFIELD C. DUNCAN—3 Management of diabetes during acute infections and surgical complications
SAMUEL BRADBURY—4 Surgical follow up and group practice

PHILADELPHIA CENTRAL HOSPITAL

HULLEY R. OWEN, JOHN PAUL NORTH and ELWIS C. MANCINI—130 Operative and dry clinic
JOSEPH MCARLAND and staff—2 Radiological clinic
Diagnosis of new cases, review of old cases and group discussion
RUBIN M. LEWIS and staff—330 Treatment of varicose veins and their complications
I. S. HELFSKI and LEANOR VILFELT—3 Management of blood bank at the Philadelphia General Hospital
demonstration of apparatus, technique of vein section and transfusion and laboratory studies on refrigerated blood

STETSON HOSPITAL

ROBERT S. ALSTON, C. E. SCHWARTZ and TROY I. MARTIN—2 Operations
CARL F. KOENIG—2 X-ray clinic

TEMPLE UNIVERSITY HOSPITAL

WILLIAM A. STEEL and C. HOWARD McDEVITT—2 Dry clinic
General and emergency surgery
HARRY Z. HIBSHMAN, HARRY I. BACOV and staff—3 Operative and dry clinic
CARROLL S. WRIGHT—3 Dermatology and syphilology

WEST JERSEY HOMOEOPATHIC HOSPITAL

H. WESLEY JACK and staff—9 Operations Cholecystectomy

Tuesday

ABINGTON MEMORIAL HOSPITAL

JOHN FIVIN—2 Chemical problems in surgery

AMERICAN ONCOLOGIC HOSPITAL

GEORGE M. DORRANCE, JOHN W. BRANSPFIELD and FRANK ERICK A. BOTHE—10 Operative and dry clinic
Cancer of rectum
JOSEPH MCARLAND—11 Pathological demonstration
Cancer of rectum

BRYN MAWR HOSPITAL

JOHN B. FLICK and FREDERICK K. ROBBINS—9 Operations
MAX STRUMFA—2 Surgical pathology (Blood pictures in surgical infections with special emphasis on neutrophils)

CHESTNUT HILL HOSPITAL

JOHN F. McCLOSKEY, JAMES A. LEHMAN, J. M. ELLERY, JR. and JOHN J. SHOBER—10 Operations

CHILDREN'S HOSPITAL

ORVILLE KING—11 Splenomegaly in children

FITZGERALD MERCY HOSPITAL

JAMES A. KELLY—9 Operations
THOMAS J. RYAN—9 Operations

TRANSFORD HOSPITAL

LOUIS D. ENGLISH—9 Operative and dry clinic

CIRMAINTOWN HOSPITAL

EDWARD B. HODGE, WILLIAM B. SWARTZ, ROBERT S. ALSTON and STEPHEN D. WILDER—10 Operations

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

WILLIAM BAILES—9 Operations
JOHN C. HOWELL and I. I. COPIDGE—11 Operations

HAHNEMANN HOSPITAL

A. B. WEBSTER—9 Operations

HOSPITAL FOR DISEASES OF STOMACH

HERBERT R. HAWTHORNE, WILBUR W. OAKS and PAUL H. NEESE—9 Operative and dry clinic

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

I. S. RAVIN and staff—9 Biliary tract operations
J. E. RHODES The management of the hemorrhagic tendency of obstructive jaundice
I. S. RAVIN The relation of diet to liver injury
W. D. FRAZIER The control of the external loss of bile
O. V. BATSON Incisions for biliary tract operations
K. TAYLOR Anesthesia in biliary tract operations
I. S. RAVIN End results in biliary tract surgery

L. K. FERGUSON LOUIS KAPLAN and WILLIAM H. FERN—2
Painful shoulder. The differential diagnosis and treatment of painful lesions of the shoulder. acute subdeltoid bursitis chronic bursitis supraspinatus tendon rupture brachial plexus neuritis with scalenus myositis

JONES HOSPITAL

HOSCOE M. TEAHN HOKE WAMMOCK and CLARE OF A WHITCOMB—9 Operations. Panhysterectomy for carcinoma of uterine fundus application of radium for carcinoma of cervix vulvectomy for carcinoma radical neck dissection for metastatic carcinoma

Staff—11 Dry clinic

W. S. HASTINGS. A review of proposed methods of serological diagnosis of cancer

A. M. DUFF JR. The rapid diagnosis of fresh tissue HOKE WAMMOCK. The control of pain of advanced cancer with irradiation

C. A. WHITCOMB. Presentation of treated oral lesions

JEFFERSON HOSPITAL

THOMAS A. SHALLOW and staff—10 Operations ward walks

CHARLES F. NASSAU—11 Operations ward walks

GEORGE P. MILLER—2 Operative and dry clinic

J. HALL ALLEN and BENJAMIN HASKELL—3 Proctological surgery

LANKAU HOSPITAL

DANON B. PFEIFFER J. MONTGOMERY DEAYER OF DR. MARTIN—9 Operations. Presentations. Acute appendicitis in children aneurysm of the abdominal aorta simulating surgical kidney

MEMORIAL HOSPITAL

JAMES I. FIDMAN—9 Thyroid operations

METHODIST HOSPITAL

CALVIN M. SMITH JR. and staff—930 Operations

MISERICORDIA HOSPITAL

B. R. BELTRAN and F. J. CARVIN—9 Operations

GEORGE F. MILLER F. M. MCGRAW and I. T. MCINNIS—9 Operations

MOUNT SINAI HOSPITAL

BENJAMIN LIPSHUTZ and staff—9 Operations

NORTHEASTERN HOSPITAL

JOSEPH J. TOLAND—9 Operations

PENNSYLVANIA HOSPITAL

WALTER I. LEE and staff—9 Operative and dry clinic

PHILADELPHIA GENERAL HOSPITAL

I. K. FERGUSON and WILLIAM H. FERN—9 Operative and dry clinic

DAVID I. ANDERSON JR.—9 Ind. results of hemorrhaphy Ferguson operation plus steel wire sutures

Staff—2 Symposium on biliary tract and gastric diseases L. K. FERGUSON Biliary tract surgery

TRUMAN G. SCHNABEL Biliary tract disease from a medical standpoint

F. BURVILLE HOLMES Roentgenological diagnosis of biliary tract disease

RUSSELL S. BOLES HELENA RIGGS and JOHN C. CRIFTHS Circulatory factors in the etiology of peptic ulcer

W. WAYNE BABCOCK Gastric surgery

HERMAN OSTROM Roentgenological aspects of gastric disease

WILLIAM BRODY Use of gastroscope in gastric disease
I. S. INFLESMI and ELIZABETH VALENTINE—3 Management of blood bank at the Philadelphia General Hospital demonstration of apparatus technique of venesection and transfusion and laboratory studies on refrigerated blood

REBYATHRIAN HOSPITAL

EDWARD B. HODGE, FREDERICK C. WILLIAMSON and LYNN M. RANNEY—9 Operative and dry clinic

RHODE ISLAND HOSPITAL

J. M. BOVAIN and staff—9 Operations

ST. CHRISTOPHER'S HOSPITAL

HARRY F. FLOYD JOHN WOLF and DR. MARTIN—10 Pediatric surgery

ST. JOSEPH'S HOSPITAL

A. C. BIERDEN—10 Dry clinic Duodenal ulcer pylorus spasm infantile pyloric stenosis

ST. LUKE'S AND CHURCH HOSPITAL

DESIDERIO ROMAN R. W. LARER H. K. ROSSNER A. W. HAMMER and staff—9 Operative clinic Thyroid gland bladder carcinoma of the breast hemorrhoides

JOHN O. BOWEN and staff—9 Dry clinic Operations on the stomach showing advantages in use of very free size calgut

J. W. POST—9 Roentgenological examinations

(1) F. BARTHELEMY—9 Demonstration Pathological and bacteriological examinations

ST. MARY'S HOSPITAL

W. J. LYNN and J. J. CANCELMO—9 Operations

A. R. MANNING—1 Proctological clinic

ST. VINCENT'S HOSPITAL

J. J. CANCELMO—9 Operative and dry clinic (ryptorchidism its reduction by operative measures

TEMPLE UNIVERSITY HOSPITAL

W. WAYNE BABCOCK C. MACON AUSTLEY W. FURRY RYAN and J. NORMAN COOMBS—9 Operations

W. EDWARD CHAMBERLAIN and staff—9 Radiological clinic

WILLIAM A. STEEL and C. HOWARD McDEWITT—2 Central and emergency surgery

USNAVAL HOSPITAL

F. I. CONNELL W. T. LINDBERY and H. L. PUGH—9 Operations

J. J. WHITE—9 Demonstration Kettering Simpson by perthorm

J. J. WHITE—1 Demonstration Kettering Simpson by perthorm

WEST JERSEY HOMIOPATHIC HOSPITAL

H. WESLEY JACK and staff—10 Operations Cholecystectomy and appendectomy

WOMEN'S HOMIOPATHIC HOSPITAL

LAWRENCE GOLDBACHER—3 Rectal surgery

WOMAN'S MEDICAL COLLEGE HOSPITAL

J. ST. MARTIN ROSEMAN and associates—1030 Operations

Wednesday

ABINGTON MEMORIAL HOSPITAL

DAMON B. PEFFIFFER, J. WALTER LEVERING and J. M. DEANER—7 Operations

BROAD STREET HOSPITAL

A. B. WEBSTER and T. C. GARY—10 Operations

BRYN MAWR HOSPITAL

ARTHUR E. BILLINGS and CHARLES H. HARNEY—9 Operations

CHISTNUT HILL HOSPITAL

WILLIAM B. SWARTLEY, S. DANA WEDDER, EDWARD F. McLAUGHLIN and WILLIAM SWARTLEY RYKER—10 30 Operations

COOPER HOSPITAL

PAUL M. MCCRACK, I. J. DEIBERT, F. W. SHAFER and R. S. GAMON—9 Operative and dry clinic Abdominal and thoracic surgery empyema

FITZGERALD MERCY HOSPITAL

BASIL R. BELTRAN—9 Operations
ALEXANDER E. BURKE—9 Operations

FRANKFORD HOSPITAL

BENJAMIN H. CHANDLER and RALPH W. LORRY—9 Operations

GERMANTOWN HOSPITAL

CHARLES F. MITCHELL, WALTER E. LEE, HARRY E. KNOX and THOMAS M. DOWNS—10 Operations

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

WALTER F. LEE—9 Operative and dry clinic Constrictive pericarditis
GEORGE M. PETERSON, GEORGE C. GRIFFITH and WALTER E. LEE—10 Dry clinic Calcified constricting pericarditis medical and surgical aspects
JOSEPH T. BEARDWOOD, JR., JOSEPH C. YASKIN and WALTER C. LEE—11 Symposium Pancreatic adenoma with hypoparathyroidism metabolic neurological and surgical aspects
COLLIER I. MARTIN—2 Lymphogranuloma venereum

HAHNLMANN HOSPITAL

C. A. VAN LENNEP—9 Operations

HOSPITAL FOR DISEASES OF STOMACH

SHERMAN A. LAGER—9 Operative and dry clinic
HERBERT R. HAWTHORNE, WILBUR W. OAKS and PAUL H. WESSEL—12 Operative and dry clinic

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

I. L. ELIASON and staff—9 Operations Biliary surgery
JULIAN JOHNSON Management of acute cholecystitis
ROBERT B. BROWN Hazards of cholecystectomy
WILLIAM H. FRIB Pancreatitis and gall bladder disease
F. L. ELIASON Surgical jaundice
I. L. ELIASON Biliary fistula
I. S. RAVDIN and staff—2 Dry clinic on pre and post operative care
I. S. RAVDIN The control of fluid balance and nutrition in surgical patients
FRANCIS WOOD The heart in surgical patients
H. C. BAZETT The effect of climatic conditions on blood volume

J. H. GIBSON, JR. The problem of embolus in surgical patients

J. F. RHODES The use of sulfanilamide in spreading peritonitis

S. GOLDSCHMIDT The danger of anoxemia during surgical operations

J. S. LOCKWOOD The mode of action of sulfanilamide and related compounds

NORMAN FREEMAN The management of surgical shock

I. S. RAVDIN The effect of recent advances of pre and postoperative treatment on the morbidity and mortality of surgical operations

L. K. FERGUSON, PAUL LOEFFLAD, WILLIAM H. FRIB, LOUIS KAPLAN and NORMAN FREEMAN—2 Treatment of varicose veins and ulcers injection treatment of varicose veins indications for and technique of ligation in the treatment of varicose veins treatment of varicose ulcers treatment of painful arteriosclerotic ulcers

JEFFERSON HOSPITAL

GEORGE P. MULLER and staff—9 Dry clinic

ADOLPH A. WALLING Cholangiography

GEORGE P. MULLER Subtotal gastrectomy

JAMES SURVER Carcinoma of breast tumor clinic follow up study over a 10 year period

GEORGE P. MULLER and staff—11 Operations

ROBERT LAYTON and SHERMAN EGER—11 Varicose vein clinic

J. HALL ALLEN and BENJAMIN HASWELL—1 30 Lesions of the anus and rectum

THOMAS A. SHALLOW—2 Operations Colon and rectum

JFWISH HOSPITAL

RALPH GOLDSMITH—9 Operations

MOSES BEHREND—2 Operations

JANKENAU HOSPITAL

GEORGE P. MULLER, GILSON C. ENGEL, JOSEPH O. KFEZEL or HANS MAY—9 Surgical operations Studies from the clinical and research laboratory upon cancer growth etc Demonstration in the technique of the use of the Engel May range finder and Smith Petersen nail end results and pathological studies

MEMORIAL HOSPITAL

BRUCE L. FLEMING—9 Operations

METHODIST EPISCOPAL HOSPITAL

GEORGE J. SCHWARTZ and staff—10 Operations

MISERICORDIA HOSPITAL

JAMES A. KELLY and D. C. GEIST—9 Operations

NORTH RYAN LIBERTIES HOSPITAL

BYRON GOLDSMITH and MORRIS SEGAL—9 Operative clinic

PENNSYLVANIA HOSPITAL

PAUL A. BISHOP—2 Dry Clinic Acute intestinal obstruction with x-ray diagnosis and special reference to the Abbott tube

WILLIAM A. WOLFF and RUSSELL ELKINGTON—4 Dry Clinic Chemical control of surgical patients

PHILADELPHIA GENERAL HOSPITAL

W. WAYNE BARCOCK—9 Dry clinic

WILLIAM T. LEMMON—9 Operative clinic Gall bladder disease

JOHN O. BOWER, JOHN C. BURNS and HARRY B. TRACHTENBERG—9 Demonstration of use of very fine size

catgut in gastro intestinal surgery management of spreading peritonitis due to perforated appendix with special reference to the use of convalescent lymphulize serum

HENRY S. RUTH—11 Choice of anesthetics in surgery
I. S. HNELESKI and FLEAOR VALENTINE—3 Management of blood bank at the Philadelphia General Hospital demonstration of apparatus technique of venesection and transfusion and laboratory studies on refrigerated blood

PRESBYTERIAN HOSPITAL

WILLIAM BATES JAMES R. MASON and JOHN C. HOWELL—9 Dry clinic

PROTESTANT EPISCOPAL HOSPITAL

Staff—9 Dry clinic
M. L. ALLEN X ray therapy of inflammation
J. M. BOYKIN Problems in gall bladder surgery
R. I. LAYTON Amputation in diabetic gangrene
K. H. MEADE, Jr. Acute pancreatitis

ST. JOSEPH'S HOSPITAL

S. D. SPOTTS—9 Operations
CHARLES F. NASSAU—10 Operations
L. A. SOLOFF—3 Laboratory demonstration of surgical pathology

ST. LUKE'S AND CHILDREN'S HOSPITAL

DESIDERIO KOMAN R. W. LARER H. K. ROESSLER A. W. HAMMOND and staff—9 Operative clinic
J. W. LOST—9 Roentgenological examinations
O. F. BARTHMEIER—9 Demonstration Pathological and bacteriological examinations

ST. MARY'S HOSPITAL

A. I. KEHAN—9 Operations

STETSON HOSPITAL

WILLIAM T. ILLIS and J. K. MARAS 12 Operations
CARL E. KOENIG—2 X ray clinic
ROBERT S. ALSTON C. I. SCHWARTZ and TROY F. MARTIN—2 Operations

TEMPLE UNIVERSITY HOSPITAL

W. WAYNE BABCOCK G. MAON ASTLEY W. FNURY BLUMET and J. NORMAN COOMBS—9 Operations
W. EDWARD CHAMBERLAIN and staff—9 Radiological clinic
WILLIAM A. STEPL and C. HOWARD McDEVITT—General and emergency surgery
HARRY Z. HIRSHEMAN HARRY E. BACON and staff—3 Operative and dry clinic

U. S. NAVAL HOSPITAL

I. L. CONLIN W. T. LINDBERRY and H. I. PUGH—9 Operations
J. J. WHITE—9 Demonstration Kettering Simpson hypertherm
J. J. WHITE—1 Demonstration Kettering Simpson hypertherm
C. K. YOUNGKIN—2 Demonstration Physical therapy
C. F. MORRISON—2 Demonstration Spinegrams

WOMEN'S HOMEOPATHIC HOSPITAL

R. W. LARER—9 Operations
WILLIAM L. MARTIN—1 Operations
C. L. SHOLLENBERGER—1 Operations

Thursday

ABINGTON MEMORIAL HOSPITAL

DANON B. JEFFER J. WALTER LEVERING I. M. BOYKIN J. M. DEWEER and staff—2 Dry clinic Peptic ulcer and its surgical complications

BRYN MAWR HOSPITAL

RALPH S. BROMER—9 X ray conference Diseases of bone
J. STEWART RODMAN and ALAN P. PARKER—9 30 Operations

CHESTNUT HILL HOSPITAL

WILLIAM C. SHEEHAN L. H. HERGENSHEIMER HANS MAY and H. P. MACNEAL—10 Operations
FAY A. ALEXANDER—11 Intra abdominal hernia x ray studies

CHILDREN'S HOSPITAL

WALTER F. LEE and FREDERICK ROBBINS—11 Operations and ward rounds Surgery in children

COOPER HOSPITAL

PALL M. MCCRAY I. F. DEBERT F. W. SHAFER and R. S. GAMON—9 Operative and dry clinics General surgery fractures carcinoma of breast

FITZGERALD MERCY HOSPITAL

JAMES A. KELLY—9 Operations
THOMAS J. RYAN—9 Operations

IRVINGFORD HOSPITAL

CHARLES F. NASSAU—9 Operations

GERMANTOWN HOSPITAL

EDWARD B. HODGE WILLIAM B. SWARTLEY ROBERT S. ALSTON and STEPHEN D. WELDER—10 Operations

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

HERBERT R. HAWTHORNE—9 Operations

HANNA MANN HOSPITAL

WILLIAM L. SYLIS—9 Operations

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

I. S. RAYDIN and staff—9 Gastro-intestinal operations.
I. S. RAYDIN The effect of nutritional edema on failure of stomach to empty
ALFRED STENGEL, Jr. Nutrition in gastro intestinal cases
W. D. THOMPSON, Jr. Factors conditioning wound healing in surgical patients
W. O. ABBOTT The use of the Miller Abbott tube in acute intestinal obstruction
W. D. FRAZIER Indications for operation in patients with gastric or duodenal ulcer

JEFFERSON HOSPITAL

KENNETH E. FRY—9 Peritoneoscopy as a diagnostic and in surgery
THOMAS A. SHALLOW and staff—10 Ward walks
THOMAS A. SHALLOW and staff—11 Operations
ROBERT A. REIMANN—1 Medico-surgical problem
J. HALL ALLEN and BENJAMIN HASKELL—3 Proctological operations

JEANES HOSPITAL

ROSCOE M. TEAHAN HOKE W. HAMMOCK and CLARE CE A. WHITCOMB—9 Operations Abdominoperineal resec

tion of rectum excision of carcinoma of bladder im-
plantation of radon for carcinoma of mouth
Staff—11 Dry clinic
W S HASTINGS A review of proposed methods of sero-
logical diagnosis of cancer
A M DUFF JR The rapid diagnosis of fresh tissue
HOKE WAMMOCK The control of pain of advanced can-
cer with irradiation
C A WHITCOMB Presentation of treated oral lesions

JEWISH HOSPITAL

FRANK B BLOCK—9 Operations

LANKENAU HOSPITAL

DAMON B PFEIFFER J MONTGOMERY DEEVER or DR
MARTIN—9 Surgical operations Discussion of cancer
of rectum with report of cases

METHODIST EPISCOPAL HOSPITAL

CALVIN M SMYTH JR and staff—9 Operations

MISERICORDIA HOSPITAL

B R BELTRAN and E GARVIN—9 Operations
GEORGE P MULLER, F MOGAVERO and F T MCGINNIN
—9 Operations

MOUNT SINAI HOSPITAL

BENJAMIN LIPSHUTZ and staff—9 Operations

PENNSYLVANIA HOSPITAL

WALTER E LEE and staff—9 Operative and dry clinic

PHILADELPHIA GENERAL HOSPITAL

LOUIS D ENGLETH S DALE SPOTTS and HUGH ROBERT
SON—9 Operative and dry clinic
L K FERGUSON and WILLIAM H ERB—9 Operative
clinic

Staff—9 Symposium on metabolic diseases
EDWARD S DILLON Surgical complications of diabetes
mellitus

WILLIAM H ERB Diabetic surgery
ROBERT G TORREY Medical aspects of diseases of
thyroid gland

PATRICK A MCCARTHY Surgery of thyroid gland
Staff—2 Symposium on cancer

LOUIS H CLERF Carcinoma of larynx
JOSEPH KLAUDER Malignant melanomas
LAWRENCE CURTIS Plastic procedures of treated car-
cinoma

B P WIDMANN Irradiation of superficial intra oral
carcinoma

JOHN HOWELL Treatment of carcinoma of rectum
CHARLES BEHNEY Carcinoma of ovary
JOSEPH McFARLAND To be announced
TRUMAN SCHNABEL Bronchogenic carcinoma
Staff— Symposium on general surgery

TENWICK BEKMAN and EDWARD CROSSAN Present
status of the surgical treatment of acute osteomyelitis
D B PFEIFFER Indications for gastro enterostomy in
the treatment of peptic ulcer

S DANA WEEEDER and WILLIAM LEMMOV Subtotal
gastrectomy for peptic ulcer

I S HATLESKI and FLEANOR VALENTINE—3 Manage-
ment of blood bank at the Philadelphia General Hos-
pital demonstration of apparatus technique of vene
section and transfusion and laboratory studies on
refrigerated blood

PRESBYTERIAN HOSPITAL

FLDRIDGE L ELIASON FREDERICK BOTTE and JOHN PAUL
NORTH—9 Operative and dry clinic

PROTESTANT EPISCOPAL HOSPITAL

E T CROSSAN and staff—9 Operations

ST CHRISTOPHER S HOSPITAL

HARRY E KNOX JOHN WOLF, and DR MARTIN—10
Pediatric surgery

ST JOSEPH S HOSPITAL

C S HERRMAN—9 Operations
L D ENGLETH—10 Operations
V R MANNING—2 Proctological clinic

ST LUKE S AND CHILDREN S HOSPITAL

DESIDERIO ROMAN R W LARER H K ROESSLER A W
HAMMER and staff—9 Operative clinic
JOHN O BOWER and staff—9 Dry clinic A demon-
stration of the use of 50 chromic catgut in pericardectomy
and common bile duct neurorrhaphy and tenorrhaphy
J W POST—9 Demonstration Roentgenological ex-
aminations
O F BARTHELEMY—9 Demonstration Pathological and
bacteriological examinations

ST MARY S HOSPITAL

J J TOLAND JR—9 Operations

TEMPLE UNIVERSITY HOSPITAL

W WAYNE BABCOCK G MASON ASTLEY, and J NORMAN
COOMBS—9 Operations
E EDWARD CHAMBERLAIN and staff—9 Radiological
clinic
WILLIAM A STEEL and C HOWARD McDEVITT—2 Dry
clinic General and emergency surgery

U S NAVAL HOSPITAL

I L CONKLIN W T LINEBERRY and H L PUGH—9
Operations
J J WHITE—9 Demonstration Kettering Simpson hy-
pertherm
J J WHITE—1 Demonstration Kettering Simpson hy-
pertherm

WEST JERSEY HOMEOPATHIC HOSPITAL

H WESLEY JACK and staff—10 Operations Repair of
hernias
H WESLEY JACK and staff—1 Operations Carcinoma of
breast appendectomy

WOMAN S HOSPITAL OF PHILADELPHIA

CALVIN M SMYTH JR and staff—9 Operations

Friday

ABINGTON MEMORIAL HOSPITAL

DAMON B PFEIFFER J WALTER LEVERING and J M
DEAVER—2 Operations

AMERICAN ONCOLOGIC HOSPITAL

JOHN W BRANSFIELD and GORDON CASTIGLIA—9 30
Operative and dry clinic Cancer of breast

BRYN MAWR HOSPITAL

WALTER F LEE and T MCKEAN DOWNS—9 Operations

COOPER HOSPITAL

PAUL M MCCRAY I E DEIBERT F W SHAVER and
R S GAMON—9 Operative clinic General abdominal
and thoracic surgery

FITZGERALD MERCY HOSPITAL

BASIL R BELTRAN—9 Operations
ALEXANDER E BURKE—9 Operations

GERMANTOWN HOSPITAL

CHARLES F MITCHELL WALTER E LEF HARRY F KNOX
and THOMAS M DOWNS—10 Operations

GRADUATE HOSPITAL OF UNIVERSITY
OF PENNSYLVANIA

WALTER I LEF—9 Operations

WALTER I LEF and HENRY I FROY ROCKS—11 Castro
intestinal clinic

HAIHIMANN HOSPITAL

HENRY S RUTH—2 Demonstration of sacral caudal block
JAMES D SCHOFIELD and staff—2 Operations

HOSPITAL FOR DISEASES OF STOMACH

HERBERT R HANTHORNE WILBUR W OAKS and PAUL
H NEESE—9 Operative and dry clinic

FRANCIS A MANTZ—1 Operative and dry clinic

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

E L FLIASON and staff—9 Castro intestinal operations
F L FLIASON—Management of bleeding ulcer cases

ROBERT B BROWN—Diagnostic difficulties in colonic
lesions

I A FERCLSON Colonic operations Surgical diathermy
in treatment of rectal disea e

WILLIAM H FRB Postoperative care of peptic ulcer
cases

JULIAN JOHNSON Treatment of acute ileitis

L A FERCLSON and staff—2 Treatment of diseases of
the anal canal and rectum

L H HERGESHEIMER Treatment of hemorrhoids by
injection hemorrhoidectomy in ambulatory patients
with local anesthesia

JOHN B CLFMENT Treatment of fissure in ano in am-
bulatory patients by using oil soluble anesthetics

KENNETH KRESSLER The treatment of pruritus ani

JOEL NASS Treatment of carcinoma of the rectum and
of rectal polyps by electrosurgery

PAUL H SIFFER Nonoperative treatment of ulcera-
tive colitis

L A FERCLSON One and two stage operations for
fistula in ano

JIFFEKSON HOSPITAL

GEORGE P MULLER and staff—9 Dry clinic Ward walks
and case demonstrations

JAMES SURVER Pathological demonstration Small
bowel tumors

GEORGE WILLAER Treatment of varicose veins

HOWARD H BRADSHAW Ward rounds

ROBERT LAYTON and SHERMAN EGER—11 Varicose vein
clinic

GEORGE I MULLER and staff—11 Operations

THOMAS A SHALLOW—11 Operations

Staff—1 Regular meeting of tumor clinic department of
neoplastic diseases

J HALL ALLEN and BENJAMIN HASKELL—1 30 Lesions
of the anus and rectum

JEWISH HOSPITAL

NORMAN S ROTHSCHILD—9 Operations

HENRY TUMEN—9 Gastroscopic clinic

LINKENAU HOSPITAL

GEORGE P MULLER CLISON C FUGEL JOSEPH O KEEZEL
or HANS MAY—9 Operations The surgical problems
in peptic ulcer Plastic operations

MEMORIAL HOSPITAL

JAMES I FIRMAN—9 Operations

MISERICORDIA HOSPITAL

J A KELLY and D C CEIST—9 Operations

T J RYAN—9 Operations and symposium on peripheral
vascular disea e

MOUNT SINAI HOSPITAL

BENJAMIN LIPSCHUTZ and LOUIS KAPLAN—9 Operations

Postoperative e distention perforation in appendicitis

MOSES REINEHD and staff—1 15 Operations

PENNSYLVANIA HOSPITAL

JOHN B FLICK and staff—9 Operative and dry clinic

PHILADELPHIA GENERAL HOSPITAL

PATRICK A MCCARTHY—9 Operative and dry clinic

B I WIDMANN—2 Radium and x ray therapy

PRESBYTERIAN HOSPITAL

HENRY P BROWN and ORVILLE C KING—9 Operative
and dry clinic

PROTESTANT EPISCOPAL HOSPITAL

I M BOYKIN and staff—9 Operations

ST JOSEPH'S HOSPITAL

JAMES A KELLY—10 Operations

EDWARD A MALLOY Historical exhibit commemorating
the ninetieth anniversary of St Joseph's Ho pital

ST LUKE'S AND CHILDREN'S HOSPITAL

DESIDERIO ROMAN R W LAKER H K ROESSLER A W
HAMMER and staff—9 Operative clinic

J W POST—9 Koentgenological examinations

O F BARTHMEYER—9 Demonstration Pathological and
bacteriological examinations

ST MARY'S HOSPITAL

P A MCCARTHY—9 Operations

J A KELLY and E H WEISS—9 Operations

STFTSON HOSPITAL

WILLIAM T ELLIS and J K MARLS—12 Operations

CARL F KOENIG—2 X ray clinic

ROBERT S ALSTON C E SCHWARTZ and TROY E MAR-
TIN—2 Operations

TEMPLE UNIVERSITY HOSPITAL

W WAYNE BARCOLA G MASON ASLEY W EMORY
BURNETT and J NORMAN COOMBS—9 Operations

W EDWARD CHAMBERLAIN and staff—9 Pathological
clinic

WILLIAM A STEEL and C HOWARD McDONNITT—2 Dry
clinic General and emergency surgery

CARROLL S WRIGHT—2 Dermatology and syphilology

HARRY Z HINSHMAN HARRY F JACON and staff—3
Operative and dry clinic

WEST JERSEY HOMOPATHIC HOSPITAL

H WESLEY JACK and staff—10 Operations Carcinoma
of breast

H WESLEY JACK and staff—1 Operations Appendec-
tomes

WOMAN'S MEDICAL COLLEGE HOSPITAL

HURLEY R OWEN—10 Operative clinic Hernia

JAMES LFRMAN—10 Operative clinic Thyroid

J STEWART RODMAN—10 30 Operative clinic Breast

OBSTETRICS AND GYNECOLOGY

Monday

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

Daily Scientific Exhibits

DOUGLAS P. MURPHY—Tolographic studies of uterine

motility during pregnancy and labor

JACQ O. KALINOWSKA—Exhibits showing influence of variations in pelvic configuration upon the mechanism of labor

CARL BAKERMAN—Exhibits showing the techniques for the quantitative determination of estrogens and progesterone in pregnancy urine

FRANKLIN L. PAYNE—Hormone studies in hydatidiform mole and chorion epithelioma

F. SIDNEY DUNNE—Functioning ovarian tumors

MEMORIAL HOSPITAL

Z. B. NEWTON—2 Gynecological operations

TEMPLE UNIVERSITY HOSPITAL

HARRY A. DUNCAN—12 Operative and dry clinic
Obstetrical staff—Daily exhibition and demonstration on fluid balance and weight control in pregnancy

WOMAN'S HOSPITAL OF PHILADELPHIA

ELEANOR H. BAKER and staff—1 Urological and gynecological clinic

Tuesday

BROAD STREET HOSPITAL

N. F. PAXSON and M. J. BENNETT—9 Operative and dry clinics Ovarian grafting as a therapeutic method for endocrine disorders presentation of cases of hypermenorrhea and hypo-menorrhea, pre and postoperative technique of new method of discussion and illustration by motion pictures in color

N. F. PAXSON and M. J. BENNETT—2 Operations Ovarian grafting for hyper and hypo menorrhea 4 cases

BRYN MAWR HOSPITAL

CHARLES A. BERRY—9 Gynecological operations

COOPER HOSPITAL

T. B. LEE and GORDON F. WEST—0 Operations

FITZGERALD MERCY HOSPITAL

JOSEPH V. MISSETT—11 Gynecological operations

LANEVAU HOSPITAL

E. P. BARNARD—10 Dry clinic

J. CALVIN HARTMAN—Use of Keiland forceps

LOSS B. WILSON—Obstetric analgesia

JULIAN LYON—Care of the premature baby

HAHNEMANN HOSPITAL

NEWLIN F. PAXSON and HENRY D. LAFFERTY—9 Clinical pathological conference and ward rounds Chronic nephritis and pregnancy placenta praevia 1 ray pelvimetry

HOSPITAL FOR DISEASES OF STOMACH

MARIO A. CASTALLO—11 Operative and dry clinic

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

CHARLES C. NORRIS, HOWARD C. TAYLOR, JR. and staff—9 Gynecological operations and demonstrations

CHARLES C. NORRIS, CHARLES A. BERRY, and PENDLETON TOMPKINS—2 Round table discussion The treatment of cervical carcinoma George Gray Ward New York chairman

JANES HOSPITAL

ROSCOE M. TEAR—1 Hoke W. Winkler and CLARENCE A. WHITCOMB—9 Operations Intrahysterectomy for carcinoma of uterine fundus application of radium for carcinoma of cervix vulvectomy for carcinoma radical neck dissection for metastatic carcinoma

JEFFERSON HOSPITAL

F. BROOKE BLAND—9 Gynecological operations

HARRY STICKLER—10 Obstetrical ward rounds

JOHN B. MONTGOMERY—12 Postoperative follow up clinic

J. B. BERNSTEIN and GEORGE B. BLAND—1 Demonstration of vaccine prevention of puerperal sepsis

MARIO CASTALLO—12 30 Organization and conduct of obstetrical clinic for treatment of syphilis and gonorrhea complicating pregnancy, results of ten years experience

KENSINGTON HOSPITAL FOR WOMEN

E. A. SCHUMANN, ADRIAN JOEGLIN, Z. B. NEWTON, F. J. KOWNACKI, C. T. BEECHAM and GEORGE C. HANNA, JR.—9 Gynecological operations with special reference to anesthesia Hysterectomy avertin plastic morphine and scopolamin laparotomy, ovarian cyst local cesarean section local

MISERICORDIA HOSPITAL

J. A. SHARKEY—3 Lecture Postpartum pulmonary complications

PENNSYLVANIA HOSPITAL

NORRIS W. VAUGHAN and staff—9 Operations and demonstration of cases

NORRIS W. VAUGHAN and staff—2 Demonstration of Lying In Hospital technique and procedure

SPRINGWOOD ROBINS—Admission of patient and assignment to accommodation

J. VERNON ELLSON—Prenatal care

CRAIG WRIGHT MUEHL—Special clinics

ROBERT M. SHIRLEY—Preparation of patient for labor

ROSS B. WILSON—Observation of patient in labor

CLIFFORD B. LULL—Delivery room setup obstetrical technique and procedures

JOHN C. ULLERY—Care of the patient immediately postpartum

ROBERT A. KIMBROUGH—Care of the patient throughout puerperium while in the hospital

F. SIDNEY DUNNE—Follow up and end results

PENDLETON S. TOMPKINS—Out patient clinic

RALPH M. TYSON—Care of the newborn

PHILADELPHIA GENERAL HOSPITAL

C. A. BERRY—11 Dry clinic Tumors in gynecological practice

PRESBYTERIAN HOSPITAL

GEORGE M. LAY, JAMES F. LEWIS and DONALD RIEGEL—Gynecological operations

IRESTON RETREAT

JOHN C. HIRST, ROBERT SHIRLEY and ROBERT SHOEMAKER—2 Demonstration of methods results and clinical significance of studies in Vitamin A in pregnancy as

indicated by visual purple estimation from the Feldman adaptometer surgical demonstration of technique of puerperal sterilization from first to fifth postpartum day by means of Pomeroy tubal ligation sterilization through the Pfannenstiel incision under local anesthesia motion picture in color of the new Pfannenstiel B. C. Hirst Ketr extraperitoneal cesarean section follicle cysty operation if case is available

ST LUKE'S AND CHILDREN'S HOSPITAL

WARREN C. MERZEL and staff—9 Operative clinic
Supravaginal repairs and vaginal hysterectomies

ST VINCENT'S HOSPITAL

WILLIAM F. MORRISON—10 Female gonorrheal clinic
Administering cauterization and exhibition of cauterized cases

STITSON HOSPITAL

STEPHEN E. TRACY and staff—9 Gynecological clinic

TEMPLE UNIVERSITY HOSPITAL

J. O. AROLD—3 Obstetrical clinic round table discussion

WOMEN'S HOMOEOPATHIC HOSPITAL

F. L. HIGGINS—9 Gynecological clinic

WOMAN'S HOSPITAL OF PHILADELPHIA

MARGARET C. STURGIS and staff—9 Operative and dry clinics
Gynecological sterility
ALBERTA FELTZ and staff—9 Frenatal clinic

Wednesday

AMERICAN ONCOLOGIC HOSPITAL

STEPHEN E. TRACY, A. VALGHAN WINCHELL and EMMETT F. CICCONI—10 Operative and dry clinic Cancer of cervix

BRYN MAWR HOSPITAL

JAMES L. RICHARDS—9 Gynecological operations Suspension of uterus and hysterectomy

CHESTNUT HILL HOSPITAL

EDWARD A. SCHLIMMANN and CLAYTON T. BEECHAM—9 30 Operations
FRANKLIN L. PAYNE—9 Operations

FITZGERALD MERCY HOSPITAL

W. BENSON HARER—9 Gynecological operations

FRANKFORD HOSPITAL

GEORGE C. HANNA, JR. and WALLACE M. MARTIN—1 30 Operative and dry clinics Obstetrical

GERMANTOWN HOSPITAL

E. P. BARNARD and J. CALVIN HARTMAN—9 Operative and dry clinics

J. CALVIN HARTMAN Discussion on prenatal care

Z. B. NEWTON Operations
WINSTON TOMPKINS Relationship between diet and the anemias of pregnancy

CHRISTOPHER M. TORMAN Interpartum separation of the pubic symphysis

TRAY MARTIN Use of typhoid vaccine in phlebitis

JOHN W. CUTLER Signs and symptoms of premature separation not always test book type

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

W. R. NICHOLSON—9 Gynecological operations

HAHN MANN HOSPITAL

EDDY CLEMMER and EDWIN I. PAXSON—2 Obstetrical operations

HOSPITAL FOR DISEASES OF STOMACH

FRANCIS H. LAYTON—2 Urethral lesions in women

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

CARL I. BACHMAN and staff—9 Obstetrical operations and demonstrations

DOUGLAS P. MURPHY and PAUL O. KLINGENSMITH—2 Round table discussion The relative importance of disproportion and inertia uteri in failed trial labor
WILLIAM F. CALDWELL New York chairman

JEFFERSON HOSPITAL

BROOKE M. ANSPACH JOHN B. MONTGOMERY and staff—9 Operations

THADDEUS L. MONTGOMERY MARIO CASTALLO and CLYDE SPANGLER—9 Operations

ARTHUR FIRST—12 Indocrine factors in the vitality and development of the fetus

ABRAHAM KARLOFF—12 New methods in the titration of prolan and estrin results of such titration in normal and complicated pregnancies

L. G. FEO—12 Studies in the parasitology and bacteriology of the vagina

LEOPOLD COLOSTEIN—12 Glycogen content and acidity of the vagina in pregnancies and its complications

MEMORIAL HOSPITAL

A. W. VOEGELIN—2 Gynecological operations

METHODIST EPISCOPAL HOSPITAL

I. C. HAMBLOCK and staff—9 Obstetrical operations and demonstration of Caldwell Morton apparatus for pelviography

MOUNT SINAI HOSPITAL

CHARLES MAZER and staff—9 Operations Exhibition and motion pictures Investigative problems of the barren marriage

PENNSYLVANIA HOSPITAL

NORRIS W. VAUC and staff—9 Operations and demonstration of cases

PHILADELPHIA COUNTY MEDICAL SOCIETY

Demonstration of Committee Activities—4 30 Each committee will take a half hour and discuss three typical deaths in their respective group Round table discussion

PHILIP F. WILLIAM chairman Committee on Maternal Welfare

THADDEUS L. MONTGOMERY chairman Committee on the Study of Fetal Deaths

RAEGER TYSON chairman Committee on the Study of Neo Natal Deaths

PRESBYTERIAN HOSPITAL

CHARLES BENNEY and JOHN GRIFFITH—9 Gynecological clinic

ST JOSEPH'S HOSPITAL

F. H. MAHER—11 Gynecological operations

HARRY STICKERT—11 Obstetrical clinic

J. F. CARROLL—2 Obstetrical clinic

ST MARY'S HOSPITAL

L. J. WOJCZYNSKI—9 Gynecological clinic

J J CARRERAS—9 Obstetrical clinic
J M LAFERTY—1 Obstetrical clinic
W H SCHMIDT—Radiological clinic

TEMPLE UNIVERSITY HOSPITAL

J O ARNOLD—3 Obstetrical clinic round table discussion

WOMAN'S HOSPITAL OF PHILADELPHIA

ALBERTA PELTZ and staff—9 Prenatal clinic

Thursday

BROAD STREET HOSPITAL

N F PAXSON and M J BENNETT—9 Demonstration New method of studying ovarian activity and the menstrual cycle by means of human vaginal smears Lantern slide demonstration and visit to laboratory showing technique Normal cycle artificial castration menopause hypermenorrhea hypomenorrhea
N F PAXSON and M J BENNETT—2 Clinical conference Ovarian graft as a therapeutic method for endocrine disorders presenting cases of castration and menopause postoperative follow up discussion of technique used illustrated by motion pictures in color

BRYN MAWR HOSPITAL

J O GRIFFITHS and J Y HOWSON—2 Obstetrical clinic

COOLER HOSPITAL

T B LEE and GORDON F WEST—9 Operative clinic Gynecological
A H DAVIS and G B GERMAN—2 Operative and dry clinic Maternal mortality in New Jersey

FITZGERALD MERCY HOSPITAL

JOSEPH V MISSETT—11 Gynecological operations

HEINEMANN HOSPITAL

EARL B CRAIG and FRANK J FROSCHE—9 Operative and dry clinic Gynecological
EARL B CRAIG and FRANK J FROSCHE—2 Operative and dry clinic Gynecological

HOSPITAL FOR DISEASES OF STOMACH

TORRY A GRFCO—9 Interposition and Fothergill operations
J S KAUFMAN—11 Operative and dry clinic

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

CHARLES C NORRIS HOWARD C TAYLOR JR and staff—9 Gynecological operations and demonstrations
FRANKLIN I LAYNE—2 Round table discussion The diagnosis and treatment of hydatidiform mole and chorionepithelioma BENJAMIN I WATSON New York chairman

JEFFERSON HOSPITAL

LEWIS C SCHEFFY I CHARLES LINTON and staff—9 Operations
CYRIL M SPANGLER—10 Ward rounds
M M GINSBERG—10 30 Cystoscopic clinic
EDWARD BURT—11 Studies in fetal asphyxia
THADDEUS I MONTGOMERY—11 Intrapartum factors in fetal and maternal mortality
JOHN H DUGGER—11 A study of rupture of the uterus
Staff—12 Round table discussion The practical application of endocrine therapy in gynecological and obstetrical practice Discussion to be participated in by a number of the leading gynecologists and obstetricians
I CHARLES LINTON—12 Postoperative follow up clinic

BROOK E ANSPACH and LEWIS C SCHEFFY—3 Clinical conference on gynecology

MOUNT SINAI HOSPITAL

BERNARD MANN and staff—9 Operations

NORTHEASTERN HOSPITAL

ALFRED H DIEBEL—10 Gynecological operations

PENNSYLVANIA HOSPITAL

NORRIS W VAUX and staff—9 Operations and demonstration of cases

NORRIS W VAUX and staff—2 Demonstration of Lying In Hospital technique and procedure

SPOTSWOOD ROBINS Admission of patient and assignment to accommodation

J VERNON ELLSON Prenatal care

CRAIG WRIGHT MCKEE Special clinics

ROBERT M SHREY Preparation of patient for labor

ROSS B WILSON Observation of patient in labor

CLIFFORD B LULL Delivery room setup obstetrical technique and procedure

JOHN C ULLERY Care of the patient immediately post partum

ROBERT A KIMBROUGH Care of the patient throughout puerperium while in the hospital

I SENEY DUNN Follow up and end results

PENDELTON TOMPKINS Out patient clinic

RALPH M TYSON Care of the newborn

PHILADELPHIA GENERAL HOSPITAL

EDWARD A SCHUMANN JOSEPH MISSETT JR WILLIAM ELY and C BECHAM—9 Gynecological operations

PRISBYTERIAN HOSPITAL

GEORGE M LAWS and staff—2 Gynecological operations
PHILIP F WILLIAMS—2 Demonstration of prenatal clinic

ST JOSEPH'S HOSPITAL

WILLIAM J THURDUM—11 Operations Hysterectomy for fibromyoma Fothergill operation for procidentia

ST LUKE'S AND CHILDREN'S HOSPITAL

EDWARD AVERETT and staff—10 Operative clinic Vaginal approach to pelvic pathology and vaginal hysterectomies Kerr low cervical cesarean section

ST MARY'S HOSPITAL

J G SABOL—9 Gynecological clinic

STITSON HOSPITAL

SILPHIE E TRACY and staff—9 Gynecological clinic

WEST JERSEY HOMIOPATHIC HOSPITAL

C F HADLEY F C HESSERT and staff—10 30 Gynecological operations

WOMAN'S HOMIOPATHIC HOSPITAL

W C MERCER—9 Gynecological clinic

WOMAN'S MEDICAL COLLEGE HOSPITAL

FAITH S FETTERMAN—9 Demonstration of patients and technique Fulguration treatment of ulcerative sub mucous cystitis

MARCELT C STURGIS—10 Demonstration Uterosal pinguography technique and evaluation of uterosal pinguograms

CATHARINE MACFARLANE and HELEN JAGLEBY—11 Round table conference Value of periodic pelvic exam

inations in preventing cancer of the uterus report on the findings in 1250 volunteers

CATHARINE MACFARLANE and staff—2 Gynecological operations

Friday

IROAD STREET HOSPITAL

W C MFCER—9 Operations Uterine fibroid hysterectomy anterior and posterior colporthaphy uterine suspension

BRYAN MAWR HOSPITAL

JOHN B MONTGOMERY and THOMAS J COSTELLO—2 Resumé of obstetrical clinic

CHESTNUT HILL HOSPITAL

Z B NEWTON and H CURTIS WOOD—11 Operations

FITZGERALD MERCY HOSPITAL

W BENSON HARPER—9 Gynecological operations

HAHNIMANN HOSPITAL

HENRY I CROWTHER and RICHARD R CATES—10 Care of premature baby management of abortion

HOSPITAL FOR DISEASES OF STOMACH

HARRY STICKFERT—11 Gynecological operations

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

CARL BACHMAN and staff—9 Obstetrical operations and demonstrations

PHILIP I WILLIAMS—12 Round table discussion Treatment of abortion FREDERIC J TALSIE St Louis Missouri chairman

JEFFERSON HOSPITAL

I BROOKS BLAND—9 Operations
JAMES L RICHARDS THOMAS J COSTELLO and DAVID M FARRELL—9 Operations

CLYDE SPANGLER—10 Ward rounds
LEWIS C SCHEFFY and WILLIAM J TRUDRUM—11 30 Uterine cancer follow up clinic

JACOB HOFFMAN—12 Endocrinological clinic
NORRIS W VALY and HOBART A REISMANN—12 Sym

porium Pulmonary complications in obstetrical and surgical practice

KENSINGTON HOSPITAL FOR WOMEN

WALTER M HEYL—9 Demonstration of the use of a placental blood bank

MR STEINBERG and MR BROWN—9 Demonstration of the principles of blood coagulation and the control of hemorrhages

L A SCHUMANN and staff—9 Obstetrical operations

MOUNT SINAI HOSPITAL

CHARLES MAZER and staff—9 Operations

PENNSYLVANIA HOSPITAL

NORRIS W VALY and staff—9 Operations and demonstration of cases

PHILADELPHIA CENTRAL HOSPITAL

CHARLES S MILLER and FRANKLIN F OSTERHOFF—1 Operative and dry clinic

ST JOSEPH'S HOSPITAL

D S O'DONNELL—11 Obstetrical clinic

F W CISHOOL—12 Obstetrical clinic

TEMPLE UNIVERSITY HOSPITAL

HARRY A DUNCAN—12 Operative and dry clinic Gynecological

J O ARNOLD—3 Dry clinic and round table discussion Obstetrics

WOMAN'S MEDICAL COLLEGE HOSPITAL

ANN GRAY TAYLOR—2 Obstetrical clinic Abnormal cases

Days to be Announced

JEWISH HOSPITAL

C J STAMM JACOB WALKER and PHILIP F WILLIAMS Operations

PRESBYTERIAN HOSPITAL

COLMAN FOLGARD Operative and dry clinic Obstetrics

GENITO URINARY SURGERY

Monday

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

JOSEPH C BIRDSALL and staff—2 Operative and dry clinic

ST JOSEPH'S HOSPITAL

WILLIAM J EICKSON—7 Diagnostic clinic

ST MARY'S HOSPITAL

W H HAYNES—1 Operative and dry clinic

TEMPLE UNIVERSITY HOSPITAL

W HERSEY THOMAS and staff—3 Operative and dry clinic

Tuesday

GERMANTOWN HOSPITAL

STANLEY O WEST and HAROLD S RAMBO—10 Operative and dry clinic

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

WILLIAM H MACKINNEY and EDWARD A MULLEN—2 Operative and dry clinic

HAHNIMANN HOSPITAL

LION T ASHCROFT and WILLIAM HUNNICKER JR—2 Operation

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

ALEXANDER RANDALL and staff—2 Operations

JEFFERSON HOSPITAL

D M DAVIS—9 Diagnostic clinic ward walk

JEWISH HOSPITAL

JOHN B TOWNES—9 Operations
LEON SOLIS CORF—9 Urological radiological exhibit

MOUNT SINAI HOSPITAL

MAURICE MUSCHAT and staff—130 Operations

ST LUKE'S AND CHILDREN'S HOSPITAL

L. F. MILLIKEN and staff—2 Dry clinic Plastic surgery of the kidney demonstration of cases

TEMPLE UNIVERSITY HOSPITAL

W. HERSEY THOMAS and staff—3 Operative and dry clinic

U. S. NAVAL HOSPITAL

V. H. CARSON and C. E. GAYLER—9 Operations
V. H. CARSON and G. E. GAYLER—2 Dry clinic

Wednesday

ABINGTON MEMORIAL HOSPITAL

ALEXANDER RANDALL and staff—9 Operations

CHESTNUT HILL HOSPITAL

ALEXANDER RANDALL, FREDERICK S. SCHOFIELD and FRANK I. MASSANISO—11 Operations

COOILR HOSPITAL

D. F. BENTLEY and R. BETANCOURT—2 Operative and dry clinic Prostatic surgery

GERMANTOWN HOSPITAL

JOHN B. LOWNES, F. S. SCHOFIELD and FRANK P. MASSANISO—10 Operative and dry clinic

HAHNEMANN HOSPITAL

LEON T. ASHCRAFT and WILLIAM HUNSICKER, JR.—9 Operations

JEFFERSON HOSPITAL

D. M. DAVIS and staff—9 Operations
KARL KORNBLUM—9 Urological radiological cases

PHILADELPHIA GENERAL HOSPITAL

WILLIAM H. MACKINNEY, W. HERSEY THOMAS, WILLARD H. KINNEY, and EDWARD A. MULLEN—9 Symposium on genito urinary diseases

PROTESTANT HOSPITAL

JOSEPH C. BIRDSALL, FRANCIS G. HARRISON and HENRY SANGREE—2 Operative and dry clinic

ST LUKE'S AND CHILDREN'S HOSPITAL

L. W. CAMPBELL and staff—9 Operative and dry clinics

ST MARY'S HOSPITAL

W. H. HAINES—2 Operations

Thursday

AMERICAN ONCOLOGIC HOSPITAL

A. E. BOTHE and FREDERICK F. CICcone—10 Operative and dry clinic Cancer of genito urinary tract

CHESTNUT HILL HOSPITAL

FREDERICK S. SCHOFIELD—9 Operations

GERMANTOWN HOSPITAL

STANLEY Q. WEST and HAROLD S. RAMBO—10 Operative and dry clinic

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

ALEXANDER RANDALL and staff—2 Dry clinic
P. B. HUGHES Bilateral functional effect of unilateral renal denervation in nephrosis
S. W. MULHOLLAND Relationship of urology to the problem of hypertension
ALEXANDER RANDALL The etiology of renal calculus
E. P. PENDEGRASS and P. B. HUGHES The value of serial pyelography in evaluating the efficiency of urinary transportation
Staff members Informative case reports

JEFFERSON HOSPITAL

D. M. DAVIS and staff—9 Operations

MEMORIAL HOSPITAL

L. A. MULLEN—3 Operations

MISERICORDIA HOSPITAL

A. E. BOTHE—2 Operations

MOUNT SINAI HOSPITAL

MAURICE MUSCHAT and staff—130 Operations

PENNSYLVANIA HOSPITAL

LEON HERMAN and staff—2 Operative and dry clinic

TEMPLE UNIVERSITY HOSPITAL

W. HERSEY THOMAS and staff—3 Operative and dry clinic

U. S. NAVAL HOSPITAL

V. H. CARSON—2 Dry clinic

WOMEN'S HOMEOPATHIC HOSPITAL

LEON T. ASHCRAFT—230 Operative and dry clinic

WOMAN'S MEDICAL COLLEGE HOSPITAL

FAITH S. FETTERMAN—9 Operative and dry clinic

Friday

ABINGTON MEMORIAL HOSPITAL

ALEXANDER RANDALL and staff—9 Operations

BRYN MAWR HOSPITAL

LEON HERMAN and LLOYD B. CRIGNE—2 Operations

GERMANTOWN HOSPITAL

JOHN B. LOWNES, F. S. SCHOFIELD and FRANK P. MASSANISO—10 Operative and dry clinic

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

JOSEPH C. BIRDSALL—2 Operative and dry clinic

HAHNEMANN HOSPITAL

LEON T. ASHCRAFT and WILLIAM HUNSICKER, JR.—9 Operations

JEFFERSON HOSPITAL

D. M. DAVIS and staff—9 Operations

JEWISH HOSPITAL

JOHN B. LOWNES—9 Operations
LEON SOLIS COHEN—9 Urological radiological exhibit

ALL THODIST EPISCOPAL HOSPITAL

STIRLING MOORHEAD and staff—10 Operations

MISERICORDIA HOSPITAL

A. L. BOWEN—2 Dry clinic Kidney tumors types and treatment

TEMPLE UNIVERSITY HOSPITAL

W. HERSEY THOMAS and staff—3 Operative and dry clinic

WOMAN'S HOSPITAL OF PHILADELPHIA

FAITH S. FETTERMAN and staff—9 Urological dry clinic

FRACTURES AND OTHER TRAUMAS

Monday

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

I. K. PETERSON, WILLIAM H. FRAZER, W. D. THOMPSON and LOUIS KAPLAN—2 Traumatic surgery Immediate treatment of traumatic wounds treatment of sprains by injection of local anesthesia diagnosis and treatment of knee injuries prophylaxis and treatment of tetanus prophylaxis and treatment of gas gangrene

PROTESTANT EPISCOPAL HOSPITAL

I. M. BOWEN—2 Fractures of lower third of leg industrial clinic

Tuesday

ABINGTON MEMORIAL HOSPITAL

DAVID B. PEPPER, J. WALTER LUTHER, J. MONTGOMERY DEVER and FLETCHER SMITH—4 Fracture clinic Demonstration of cases or treatment of compound fractures fracture dislocation of shoulder closed skeletal reduction cases open reduction cases clinic in operation

JEWISH HOSPITAL

MIRIAM BREUREN—9 Dry clinic Compound fractures immediate fixation and metal plates

RALPH C. GOLDSMITH and staff—9 Fracture clinic

MISERICORDIA HOSPITAL

I. MOK AVERO—11 Lecture Experiences with the Smith Petersen nail

PHILADELPHIAN HOSPITAL

JOHN FALL NORTH—9 Industrial surgery clinic

ST. JOSEPH'S HOSPITAL

J. A. LEHMAN—11 Industrial surgery clinic Living fascial suture in repair of hernia

TEMPLE UNIVERSITY HOSPITAL

JOHN ROYAL MOORE—9 Fracture clinic

WEST JERSEY HOMIOPATHIC HOSPITAL

H. WESTLEY JACK and staff—1 Operative and dry clinics Discussion and presentation of 4 cases of removal of spleen following trauma

Wednesday

COOPER HOSPITAL

Staff—9 Operative and dry clinic

NORTHASHIRAN HOSPITAL

T. TURNER THOMAS—11 Fracture clinic and motion picture demonstration Shaft and intracapsular fractures

of the femur with and without screw fixation demonstration of patients x rays and end results in fractures of tibia and fibula Pott's fractures with and without posterior dislocation of ankle and marginal fracture of tibia and fractures of os calcis fractures and dislocations at shoulder elbow and wrist

PHILADELPHIA CENTRAL HOSPITAL

Staff—2 Symposium on fractures

CLAY MURRAY S. HUBBARD, HARRISON McALCHIN

Fractures of the shoulder girdle

B. F. BUZZI Fractures about the elbow

TOM OUTLAND Fractures of the forearm

Thursday

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

ROBERT A. CROFF—0 Clinical conference Responsibility of industry in the management of head injuries

BERNARD D. JUDOVITZ—10 Dry clinic Back injuries in industrial surgery

JOHN C. HOWELL—11 Demonstration Restoration of joint function after fractures pain in groin following lifting tendon repair in industrial surgery

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

I. K. PETERSON, LOUIS KAPLAN and L. H. HERGE HENNER—2 Treatment of fractures in ambulatory patients clinical demonstration technique and application of unpadded plaster casts for the upper and lower extremities reduction of fractures under local anesthesia practical physiotherapy in fractures by active function treatment of minor ankle fractures by injection of local anesthesia

JEWISH HOSPITAL

RALPH GOLDSMITH and staff—9 Fracture clinic

MEMORIAL HOSPITAL

BRELL L. FLEMING—9 Fracture clinic

PENNSYLVANIA HOSPITAL

FREDERICK F. ROBBINS—9 Industrial clinic

Friday

COOPER HOSPITAL

R. S. CARMO and I. I. FISTINE—9 Dry clinic Fractures

ST. MARK'S HOSPITAL

W. J. KAY—9 Operative and dry clinic Industrial surgery

SURGERY OF BONES AND JOINTS

Monday

PROTESTANT EPISCOPAL HOSPITAL

RUTHERFORD L. JOHN—1 30 Orthopedic clinic

CHILDREN'S HOSPITAL

J. T. NICHOLSON— Demonstration of splints Polio myelitis Prevention of foot deformities in younger children by equalization of tendon pull, muscle and fascial transplants

MOUNT SINAI HOSPITAL

M. B. COOPERMAN—2 Operations

Tuesday

COOPER HOSPITAL

B. FRANKLIN BUZBY, OSWALD R. CARLANDER and DR. WALLIS—9 Operative and dry clinics. Fibrous injuries spinal fusion

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

DEFOREST P. WILLARD, JESSE T. NICHOLSON and BENJAMIN T. BRILL—9 Operative and dry clinics (1) Reconstruction operation in older congenital hip cases (2) unusual spine lesions responsible for backache (3) correction of metatarsus varus in hallux valgus

ST JOSEPH'S HOSPITAL

PAUL JERSON—1 Dry clinic Low back strain fusion for chronic low back strain

ST LUKE'S AND CHILDREN'S HOSPITAL

JOHN A. BROOKE—2 Dry clinic Tendon transplantation in selected polio cases arthrodesis of the knee serratus magnus paralysis with fascial anastomosis to the spinous process

SHRINER'S HOSPITAL

J. R. MOORE—2 Ward work

WOMEN'S HOMEOPATHIC HOSPITAL

I. O. GLECKELER—1 Operative and dry clinic

Wednesday

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

W. C. LEMER, L. D. FRESCOEN and PAUL JERSON—12 Operations Arthroplasty elbows and hips internal derangement of knees

J. T. NICHOLSON HOSPITAL

J. T. NICHOLSON—9 Operations

MOUNT SINAI HOSPITAL

M. B. COOPERMAN and staff—2 Operations

PROTESTANT EPISCOPAL HOSPITAL

J. W. KLOPP—10 30 Operative and dry clinics Fractures of neck of femur use of nail, in treatment RUTHERFORD L. JOHN—1 30 Operative and dry clinic

ST CHRISTOPHER'S HOSPITAL

RUTHERFORD L. JOHN—10 30 Operations

ST LUKE'S AND CHILDREN'S HOSPITAL

PAUL JERSON—10 Operative clinic Internal derangement of knee exploration polio, dactylitis plastic surgical result, nailing of fractured hip

SHRINER'S HOSPITAL

J. R. MOORE—9 Operations

U. S. NAVAL HOSPITAL

C. I. MORRISON—9 Operations

WEST JERSEY HOMEOPATHIC HOSPITAL

S. L. BROWN and staff—9 Operations

Thursday

BRYN MAWR HOSPITAL

GEORGE WAGNER—9 Operations Demonstration of selected cases of healed fractures

GERMANTOWN HOSPITAL

B. FRANKLIN BUZBY and A. D. WALLIS—9 Operative and dry clinic

HAINEMANN HOSPITAL

JOHN A. BROOKE, EDWIN GUCKELER and DONALD T. JONES—1 Dry clinic Fractures of neck of femur internal fixation Smith Petersen pin or parallel screws results of leg shortening herniation of intervertebral disc shoulder disabilities orthopedic problem cases for discussion

PHILADELPHIA ORTHOPAEDIC HOSPITAL

DEFOREST P. WILLARD and staff—9 Case demonstrations Treatment of Legg Calvé Perthes disease five year results of slipped femoral epiphysis decompression of abscess for paraplegia in Pott's disease

ST JOSEPH'S HOSPITAL

PAUL JERSON—1 Operation Fusion for chronic low back strain

SHRINER'S HOSPITAL

J. R. MOORE—9 Demonstration of out patient clinic

TEMPLE UNIVERSITY HOSPITAL

JOHN ROYAL MOORE—1 Operations

U. S. NAVAL HOSPITAL

C. I. MORRISON—2 Dry clinic

Friday

COOPER HOSPITAL

B. FRANKLIN BUZBY, OSWALD R. CARLANDER and DR. WALLIS—9 Operative and dry clinic Knee injuries

J. T. NICHOLSON HOSPITAL

J. T. NICHOLSON, E. A. BRAY, HENRY SIMMOND and M. T. HORN—12 Dry clinic Arthroplasty and resection of the elbow malignant tumors, backache lesions of the knee joint

MOUNT SINAI HOSPITAL
M B COOPERMAN and staff—2 Operations

ST CHRISTOPHER'S HOSPITAL
RUTHERFORD L JOHN—10 30 Operations

SIRLINER'S HOSPITAL
J R MOORE—9 Operations
Days to be Announced
PRESBYTERIAN HOSPITAL
BRUCE GILL Operative and dry clinic

NEUROSURGERY

Tuesday

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA
FRANCIS C CRANT and staff—9 Operative and dry clinic
Major trigeminal neuralgia (motion pictures)

JEFFERSON HOSPITAL
WILLIAM DUANE JR—9 Operations

TEMPLE UNIVERSITY HOSPITAL
TEMPLE S FAY—9 Operations

Wednesday

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA
FRANCIS C CRANT and staff—9 Dry clinic Motion picture demonstration of the treatment of spinal cord injuries

MISERICORDIA HOSPITAL
T J KVAN—9 Operative and dry clinic Craniocerebral injuries

TEMPLE UNIVERSITY HOSPITAL
TEMPLE S FAY—9 Operations

Thursday

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA
FRANCIS C CRANT and staff—9 Craniotomy for a brain tumor

JEFFERSON HOSPITAL
WILLIAM DUANE JR—9 Operations

Friday

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA
FRANCIS C CRANT and staff—9 Dry clinic Diagnosis and treatment of pituitary disease

JEFFERSON HOSPITAL
BERNARD J ALPERS and WILLIAM DUANE JR—10 Brain tumors diagnosis and treatment

TEMPLE UNIVERSITY HOSPITAL
TEMPLE S FAY—9 Operations

PLASTIC AND MAXILLOFACIAL SURGERY

Monday

CHESTNUT HILL HOSPITAL
CHARLES W CAISLER—2 Operations

NORTH PENN LIFE RTHS HOSPITAL
SAMUEL COHEN—2 Nasal plastic surgery

Tuesday

JEFFERSON HOSPITAL
WARREN B DAVIS—9 Operations

PENNSYLVANIA HOSPITAL
JAMES R CAMERON—2 Operations

PRESBYTERIAN HOSPITAL
ROBERT H IVY LAWRENCE CURTIS and HENRY A MILLER—
9 Operative and dry clinic Facial reconstructions

Wednesday

GRADUATE HOSPITAL OF UNIVERSITY
OF PENNSYLVANIA
SAMUEL COHEN—3 Nasal plastic operation

Thursday

AMERICAN ONCOLOGIC HOSPITAL
GEORGE M DORRANCE and JOHN W BRANSFIELD—11
Dry clinic

GRADUATE HOSPITAL OF UNIVERSITY
OF PENNSYLVANIA
EDWARD B SPAETH—2 Plastic surgery of the eye

JEFFERSON HOSPITAL
WARREN B DAVIS—9 Operations

Friday

GRADUATE HOSPITAL OF UNIVERSITY
OF PENNSYLVANIA
ROBERT H IVY LAWRENCE CURTIS and HENRY A MILLER
—9 Operations

HAINEMANN HOSPITAL
THOMAS L DOYLE—9 Operations

MOUNT SINAI HOSPITAL
A Frank—2 Operations

ST JOSEPH'S HOSPITAL
WILLIAM J MCKINLEY—9 Operative and dry clinic

THORACIC SURGERY

Tuesday

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

I S RAVDIN and staff—2 Dry clinic

RICHARD H MEADE The surgical treatment of pulmonary tuberculosis

GABRIEL TUCKER The bronchoscopic aspects of thoracic surgery

JULIAN JOHNSON The surgical treatment of pulmonary malignancy and bronchiectasis

JEFFERSON HOSPITAL

HOWARD H BRADSHAW and GEORGE WILLAUGER—21 30 Dry clinic Thoracic diseases

PHILADELPHIA GENERAL HOSPITAL

Staff—9 Symposium on empyema atelectasis sulfur pyridine

E I FLIASON Empyema results

E BURYILLE HOLMES Roentgenological aspects of empyema

LEON SCHWARTZ Clinical studies on sulfurpyridine

V W MURRAY WRIGHT Basal atelectasis following general surgical operations

MOSES BEHRND RICHARD H MEADE JR RUBIN M LEWIS and ALBERT BENKEND—2 Operative and dry clinics Phrenic nerve operations pneumolysis thoracoplasty extrapleural pneumothorax

Wednesday

GRADUATE HOSPITAL OF UNIVERSITY

OF PENNSYLVANIA

WALTER E LEE—50 Constrictive pericarditis

JEFFERSON HOSPITAL

HOWARD H BRADSHAW and GEORGE WILLAUGER—2 Operative clinic Thoracic diseases

PENNSYLVANIA HOSPITAL

JOHN R FLICK and staff—9 Operative and dry clinic

JOHN T BAUER—3 Dry clinic Carcinoma of the lung diagnosis by sputum examination

PROTESTANT EPISCOPAL HOSPITAL

RICHARD H MEADE—9 Operative and dry clinic Thoracoplasty for pulmonary tuberculosis

Thursday

GRADUATE HOSPITAL OF UNIVERSITY

OF PENNSYLVANIA

J W CUTLER—2 Operations Extrapleural and intrapleural pneumolysis in surgical therapy of tuberculosis

TEMPLE UNIVERSITY HOSPITAL

W TIMOTHY BURNETT—9 Operative clinic

Staff—2 Dry clinic Thoracic diseases (chest conference)

BRONCHOESOPHAGOLOGY

(See also clinical schedules under Otorhinolaryngology)

Monday

TEMPLE UNIVERSITY HOSPITAL

CHEVALIER L JACKSON and staff—1 Bronchoesophagological clinic Bronchoscopy as an aid to the thoracic surgeon

Tuesday

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

GABRIEL TUCKER WILLIAM A LELL and J I ATKINS—9 Direct laryngoscopy

GABRIEL TUCKER—2 Dry clinic Laryngeal tumors benign and malignant, demonstration of patients and colored motion pictures on the technique of direct laryngoscopy laryngofissure and laryngectomy

JEWISH HOSPITAL

LOUIS H CLERF R M ATKINS and C J SWALM—3 Bronchoscopic clinic

PHILADELPHIA GENERAL HOSPITAL

GEORGE A RICHARDSON—9 Bronchoscopic clinic

PROTESTANT EPISCOPAL HOSPITAL

WILLIAM A LELL—Bronchoscopic clinic Motion picture demonstration The larynx

TEMPLE UNIVERSITY HOSPITAL

CHEVALIER L JACKSON—11 Dry clinics Diseases of the esophagus diverticulum of the hypopharynx and one stage operation for its surgical cure (motion pictures)

Wednesday

JEFFERSON HOSPITAL

LOUIS H CLERF—9 Bronchoscopic clinic

MISERICORDIA HOSPITAL

GABRIEL TUCKER JOSEPH P ATKINS and WILLIAM A LELL—2 Operative and dry clinic

MOUNT SINAI HOSPITAL

W A LELL and staff—10 Operative and dry clinic

PHILADELPHIA GENERAL HOSPITAL

LOUIS H CLERF—1 Bronchoscopic clinic Malignant tumors

WOMAN'S MEDICAL COLLEGE HOSPITAL

EMILY VAN LOON and associates—9 Bronchoscopic clinic

Thursday

FRANKFORD HOSPITAL

GEORGE A RICHARDSON—1 30 Bronchoscopic clinic

GRADUATE HOSPITAL OF UNIVERSITY

OF PENNSYLVANIA

GABRIEL TUCKER WILLIAM A LELL and J P ATKINS—9 Bronchoscopic clinic

JEFFERSON HOSPITAL

LOUIS H CLERF—1 Bronchoscopic clinic

NORTH CAROLINA HOSPITAL

N M LEVIN—9 Bronchoscopic clinic

PHILADELPHIA CLINICAL HOSPITAL

GEORGE WHELAN—9 Bronchoscopic clinic

ST CHRISTOPHER'S HOSPITAL

EMILY VAN LOON—9 Bronchoscopy in allergic children

TEMPLE UNIVERSITY HOSPITAL

CHEVALIER I JACKSON and staff—2 30 Broncho esophageal clinic 4 30 Chest conference

U S NAVY HOSPITAL

F HARBERT—2 Bronchoscopic clinic

Friday

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

GABRIEL TUCKER and WALTER F ILL—10 Surgical management of esophageal diverticula

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

GABRIEL TUCKER WILLIAM A ILL and J P ATKINS—9 Bronchology and esophagology

TEMPLE UNIVERSITY HOSPITAL

CHEVALIER I JACKSON and WILLIAM A SWALM—11 Gastrosopic clinic

OTORHINOLARYNGOLOGY

(See also clinical schedules under Broncho Esophagology)

Monday

BRANNAW HOSPITAL

EDWIN P LONGAKER—2 Operations

CHILDREN'S HOSPITAL

WILLIAM HENSON—1 Dry clinic Sinus infections in children diagnosis and treatment

LLOYD S HUTCHINSON and MALCOLM N WILKES—3 Operations Tonsillectomy in children

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

RALPH BITLER and WALTER POBERTS—2 Operative and dry clinic

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

HARRY P SCHENCK and LOUIS F SILCOX—2 Operations Staff—2 Dry clinic

DELAZON BOSTWICK Notes on septal surgery

JULIUS WINSTON Neuro otological clinic

L E SILCOX Subluxation of the nasal septum

J C DONNELLY Audible tinnitus presentation of patients

H P SCHENCK Carcinoma of the nasal septum

KARL M HOUSER Submucous resection of the nasal septum

JEWISH HOSPITAL

H M GODDARD—2 Operations Submucous resection tonsillectomy maxillary sinus

MOUNT SINAI HOSPITAL

M S LESNER—2 30 Operations

PENNSYLVANIA HOSPITAL

WILLIAM HENSON and THOMAS COWEN—2 Operations
EDWARD H CAMPBELL—2 Diagnostic methods in nose and throat condition

PHILADELPHIA CLINICAL HOSPITAL

HERBERT M GODDARD—2 Tonsil and submucous clinic

PRESBYTERIAN HOSPITAL

WALTER L CARISS DOUGLAS MACFARLAN RICHARD W CARLICH and I W KEMNER—2 Operative and dry clinic

ST JOSEPH'S HOSPITAL

T F GOWEN—1 Operative and dry clinic

ST MARY'S HOSPITAL

F J MURPHY—1 Operations

TEMPLE UNIVERSITY HOSPITAL

ROBERT F RIDPATH and staff—2 Rhinological clinic

WOMAN'S HOSPITAL OF PHILADELPHIA

HENRIETTA T TANNER—2 Operations Tonsillectomy and adenoidectomy

Tuesday

COOPER HOSPITAL

ORAH K KLINE ERNEST R HIRST and staff—2 Operations

FITZGERALD MERCY HOSPITAL

CORNELIUS T MCCARTHY—1 Radical mastoidectomy report on three cases of lateral sinus thrombosis with recovery Treatment of otolaryngological cases with sulfanilamide

FRANKFORD HOSPITAL

ROBERT WATT—1 30 Operative and dry clinic

GERMANTOWN HOSPITAL

H J WILLIAMS C B OWINGS C F TOWSON VALENTINE MILLER and WILLIAM HITSCHLER—2 Operative and dry clinic

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

GEORGE M COATES and BENJAMIN H SHUSTER—2 Operative and dry clinics Otolaryngology and neuro otology

HARRISMAN HOSPITAL

CHARLES B HOLLIS—2 Operations

HOSPITAL FOR DISORDERS OF STOMACH

ROBERT J HUNTER—2 Functional ear test

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

GABRIEL TUCKER WILLIAM A ILL and J P ATKINS—9 Direct laryngoscopy

JULIUS WINSTON and D S BOSTWICK—Operations
CABRILE TUCKER—Dry clinic Laryngeal tumors
 benign and malignant demonstration of patients and
 colored motion pictures on the technique of direct
 laryngoscopy laryngoscopy and laryngectomy
Staff—2 Dry clinic Surgical treatment of deafness
EDWARD H CAMPBELL—New surgical treatment of con-
 ductive deafness
OSCAR BATSON—Anatomical considerations
WALTER HUGGON—Surgery of deafness
JAMES A BABBITT—Newer phases of otosclerosis
D W BRONA—Excitation of sensory nerves by normal
 and pathological processes

JEFERSON HOSPITAL

LOUIS H CLERF—9 Cancer of larynx
H H LOTT—9 Tonsil clinic
H J WILLIAMS—1 Dry clinic Facial paralysis occurring
 during the course of chronic suppurative otitis media
 and its treatment

LANKFORD HOSPITAL

EDWARD H CAMPBELL—2 Otolaryngological clinic

METHODIST EPISCOPAL HOSPITAL

WALTER ROBERTS and staff—Operations

MISERICORDIA HOSPITAL

R J BRENNAN—Lecture Treatment of sinusitis

MOUNT SINAI HOSPITAL

D N HUSTON—130 Operations

PENNSYLVANIA HOSPITAL

ORAM KLEIN and HENRY A MILLER and HOWARD HEBBELL—
 1 Operations

ROMEO A LUONGO and ANTHONY C BRANCATO—2 Dry
 clinic Diagnostic methods in nose and throat condi-
 tions

LOUIS E SILCOX—Operations Tonsillectomy general
 anesthesia

PHILADELPHIA GENERAL HOSPITAL

LOUIS J BURMAN—2 Laryngeal tuberculosis

ST JOSEPH'S HOSPITAL

ARTHUR WIGLEY—11 Operative and dry clinic

ST LUKE'S and CHILDREN'S HOSPITAL

SEYMOUR BRUM and staff—2 Operative clinic

ST MARY'S HOSPITAL

W P GRADY—9 Operative and dry clinic

TEMPLE UNIVERSITY HOSPITAL

MATTHEW S FISHER EDWARD K MITCHELL S BRUCE
CLEVELAND and DAVID MYERS—2 Otolaryngological clinic

WEST JERSEY HOMEOPATHIC HOSPITAL

I S HALLINGER and staff—2 Operations

Wednesday

CHESNUT HILL HOSPITAL

JOHN R DAVIES JR GEORGE T FARIS and DAVID G
ORNSTON—130 Operations

CHILDREN'S HOSPITAL

I HAROLD KRAUSS—1 Sinus infections in children
 diagnosis and treatment tonsil and mastoid operations

MILFORD HOSPITAL

J I FORTY—1 Mastoid operations

RADUW HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

GEORGE B WOOD—2 Operative and dry clinic

RAHNEMANN HOSPITAL

JOSEPH V CLAY—2 Operations

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

EDWARD H CAMPBELL and OSCAR V BATSON—2 Opera-
 tions

Staff—2 Dry clinic Chemotherapy in otolaryngology

D SERGEANT PEPPER—1 Imitations of chemotherapy

H F FLIPPIN—1 Chemotherapy in meningitis

THOMAS FITZ HUGH JR—1 Hematological effects of drug

therapy
HARRY P SCHAFER—1 Procedures supplementing chemo-
 therapy

KARL M HOFFER—1 Chemotherapy in otolaryngology

E P FENDERGRASS—1 Effects of chemotherapy upon
 cytogenetical findings

JEFERSON HOSPITAL

A T SMITH—10 Tumors of nose and sinuses

H J WILLIAMS—1 Operative and dry clinic

JEWISH HOSPITAL

A S KAUFMAN—1 Mastoid operations

MISERICORDIA HOSPITAL

C T MCCARTHY—2 Operations Tonsillectomy local
 LaForce dissection submucous resection simple and
 radical mastoid results of sulfanilamide in mastoiditis

PHILADELPHIA GENERAL HOSPITAL

ROBERT J HUNTER—2 Recent advances of otology ward
 walks

PROTESTANT EPISCOPAL HOSPITAL

ALLEN BERTOLET and staff—2 Operations

ST CHRISTOPHER'S HOSPITAL

HAROLD KRAUSS and GOMER T WILLIAMS—2 Operations

ST JOSEPH'S HOSPITAL

R L DICKSON—11 Operations

ST LUKE'S and CHILDREN'S HOSPITAL

GEORGE MACKENZIE and staff—2 Demonstration of
 cases Radical mastoids

STETSON HOSPITAL

C H GRIMES and staff—12 Operative and dry clinic

TEMPLE UNIVERSITY HOSPITAL

ROBERT F FIDPATH and staff—2 Rhinological clinic

WEST JERSEY HOMEOPATHIC HOSPITAL

I S HALLINGER and staff—2 Operations

WOMAN'S HOSPITAL OF PHILADELPHIA

CATHERINE ARTHURS and staff—2 Operations

Thursday

BRYAN MAWR HOSPITAL

CHARLES A. PRYOR—2 Operations

FITZGERALD MERCY HOSPITAL

CORNELIUS F. MCCARTHY—1 Operations

GERMANTOWN HOSPITAL

H. J. WILLIAMS, C. B. OWENS, C. F. TOWSON, VALENTINE MILLER and WILLIAM HITSCHLER—2 Operations

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

PALPH BUTLER and WALTER ROBERTS—2 Operative and dry clinic

HAINEMANN HOSPITAL

CHARLES B. HOLLIS—2 Operations

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

J. C. DONNELLY and HARRY SCHLUDERBERG—2 Operations

Staff—3 Dry clinic

VALENTINE MILLER Demonstration Loose areolar tissue of the larynx

J. C. DONNELLY Allergy of the upper respiratory tract and its relation to bronchiectasis

FREDERICK H. KRAUSS New method of tonsillectomy under vinylene anesthesia

ROBERT J. HUNTER Interpreting tuning fork time in decibels

FRANCIS C. CRANT Otic brain abscess

ELLIOTT C. LARK and RICHARD ABELL Studies of reactions in living tissue

JEFFERSON HOSPITAL

A. T. SMITH—9 Tonsil clinic

A. T. SMITH—1 Sinus clinic

JEWISH HOSPITAL

H. B. COHEN—1 Operations

MEMORIAL HOSPITAL

H. J. WILLIAMS—2 Radical mastoid operations

METHODIST EPISCOPAL HOSPITAL

WALTER ROBERTS and staff—2 Operations

MISERICORDIA HOSPITAL

J. I. LOFTUS—2 Dry clinic Mastoid surgery

MOUNT SINAI HOSPITAL

MORRIS A. WEINSTEIN—2 Operations

PENNSYLVANIA HOSPITAL

WILLIAM HAWSON, ORAM KLINE and ROMEO LONGO—2 Operations

WILLIAM HAWSON, HOWARD HEBBLE and LOUIS F. SILCOX—2 Dry Clinic Diagnostic methods in nose and throat conditions

EDWARD H. CAMPBELL—2 Mastoid operation

PHILADELPHIA GENERAL HOSPITAL

BENJAMIN H. SHUSTER—2 Laryngeal tuberculosis

PROTESTANT EPISCOPAL HOSPITAL

OTTO C. HIRST and staff—2 Operations

ST. LUKE'S AND CHILDREN'S HOSPITAL

WILLIAM WHIFLAN, BENJAMIN SHUSTER and staff—2 Anterior slide demonstration showing patients before and after radical operation for disease of the frontal ethmoid and maxillary sinuses with proptosis of the eye ball

ST. MARY'S HOSPITAL

I. J. HOLLAND—1 Operative and dry clinic

TEMPLE UNIVERSITY HOSPITAL

CHEVALIER I. JACKSON and W. WAYNE BARCOCK—1 Dry clinic Surgical treatment of cancer of the larynx laryngoscopy and laryngectomy

N. M. LEVIN—1 Teaching the laryngectomized patient to talk

MATTHEW S. LESNER and staff—2 Otological clinic Demonstration of cases where labyrinthian fenestrations were performed for the relief of deafness

U. S. NAVY HOSPITAL

T. S. MORING, C. W. STELLY and F. HARBERT—9 Operative and dry clinic

WEST JERSEY HEBDOMADAL HOSPITAL

T. S. HALLINGER and staff—2 Operations

Friday

CHILDREN'S HOSPITAL

EDWARD H. CAMPBELL—1 Dry clinic Sinus infections in children diagnosis and treatment mastoid operations

FITZGERALD MERCY HOSPITAL

J. E. LOFTUS—1 Operations

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

KARL M. HOUSER and F. W. KEMNER—2 Operations

LANAENAU HOSPITAL

EDWARD H. CAMPBELL—2 Otolaryngological clinic

PENNSYLVANIA HOSPITAL

THOMAS GOWEN and HENRY A. MILLER—2 Operations

THOMAS GOWEN and EDWARD J. COUGH—2 Dry clinic

Diagnostic methods in nose and throat conditions

THOMAS GOWEN and WILLIAM DAVENHOWER—2 Operations Tonsillectomy and mastoidectomy

PHILADELPHIA GENERAL HOSPITAL

DAVID N. HUSE—2 Operative and dry clinic

ST. CHRISTOPHER'S HOSPITAL

HAROLD KRAUSS and COMER T. WILLIAMS—10 Operations

ST. MARY'S HOSPITAL

T. J. WALSH—1 Operative and dry clinic

WOMEN'S HOMEOPATHIC HOSPITAL

J. R. CRESWELL—2 Operative and dry clinic

Days to be Announced

ABINGTON MEMORIAL HOSPITAL

WALTER HUGHSON Demonstration Physiology of hearing

FREDERICK KRAUSS Discussion of mastoids

OPHTHALMOLOGY

Monday

COOPER HOSPITAL

J S SHIPMAN and staff—2 Operations

GRADUATE HOSPITAL OF UNIVERSITY
OF PENNSYLVANIA

L C PETER and staff—2 Dry clinic

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

FRANCIS HEED ADLER—2 Operative and dry clinic

JEFFERSON HOSPITAL

C E G SHANNON—2 Operative and dry clinic

LANKENAU HOSPITAL

PERCE DE LONG—2 Ophthalmological clinic

MOUNT SINAI HOSPITAL

AARON BARLOW—4 Operations

PENNSYLVANIA HOSPITAL

A G FEWELL—2 Fundus clinic

PRESBYTERIAN HOSPITAL

H M LANGDON—2 30 Operative and dry clinic

PROTESTANT EPISCOPAL HOSPITAL

ANDREW KNOX—2 Operative and dry clinic

ST CHRISTOPHER'S HOSPITAL

J B FELDMAN—2 Squint clinic

TEMPLE UNIVERSITY HOSPITAL

WALTER I LILLIF and staff—1 Operative and dry clinic

WILLS HOSPITAL

J M GRISCOM, F C PARKER and T A O'BRIEN—2
Operative and dry clinic*Tuesday*

CHESTNUT HILL HOSPITAL

GEORGE E BERNER—2 Operations

GRADUATE HOSPITAL OF UNIVERSITY
OF PENNSYLVANIA

WILLIAM T SHOEMAKER—2 Operative and dry clinic

HOSPITAL FOR DISEASES OF STOMACH

GEORGE H DENNEY—1 Cataract cases

JEFFERSON HOSPITAL

C E G SHANNON—2 Operative and dry clinic

PHILADELPHIA GENERAL HOSPITAL

C R MULLEN—3 Operative and dry clinic

PROTESTANT EPISCOPAL HOSPITAL

N M BRINKERHOFF—2 Operative and dry clinic

ST CHRISTOPHER'S HOSPITAL

J B FELDMAN—2 Squint clinic

ST LUKE'S AND CHILDREN'S HOSPITAL

I C PETERS, S H BROWN and staff—2 Operative clinic

ST MARY'S HOSPITAL

F A MURPHY—1 Operative and dry clinic

TEMPLE UNIVERSITY HOSPITAL

WALTER I LILLIF and staff—1 Operative and dry clinic

WILLS HOSPITAL

LOUIS LEHRFELD, W S REESE and C R MULLEN—2
Operative and dry clinic*Wednesday*

BRYAN MAWR HOSPITAL

T DELORME FORDYCE—2 Operative and dry clinic

GRADUATE HOSPITAL OF UNIVERSITY
OF PENNSYLVANIA

L C PETER and staff—2 Operations

GERMANTOWN HOSPITAL

CARL WILLIAMS and ALBERT C SAUTTER—10 Operations

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

FRANCIS HEED ADLER—2 Operative and dry clinic

JEFFERSON HOSPITAL

C E G SHANNON—2 Operative and dry clinic

LANKENAU HOSPITAL

PERCE DE LONG—2 Ophthalmological clinic

PRESBYTERIAN HOSPITAL

H M LANGDON—2 30 Operative and dry clinic

PROTESTANT EPISCOPAL HOSPITAL

ANDREW KNOX—2 Operative and dry clinic

ST CHRISTOPHER'S HOSPITAL

J B FELDMAN—3 Operations

ST LUKE'S AND CHILDREN'S HOSPITAL

F C PETERS, S H BROWN and staff—2 Operative clinic

WILLS HOSPITAL

JAMES S SHIPMAN, EDMUND B SPAETH and WILLIAM J
HARRISON—2 Operative and dry clinic*Thursday*GRADUATE HOSPITAL OF UNIVERSITY
OF PENNSYLVANIA

WILLIAM T SHOEMAKER—2 Operative and dry clinic

JEFFERSON HOSPITAL

C E G SHANNON—2 Operative and dry clinic

MOUNT SINAI HOSPITAL

AARON BARLOW—4 Operations

PHILADELPHIA GENERAL HOSPITAL

C R MULLEN—3 Operative and dry clinic

PROTESTANT EPISCOPAL HOSPITAL

N M BRINKERHOFF—2 Operative and dry clinic

ST. CHRISTOPHER'S HOSPITAL

J. B. FELDMAN—Squint clinic

ST. LUKE'S AND CHILDREN'S HOSPITAL

J. C. FETTER and H. BROWN and staff—9 Operations

ST. MARK'S HOSPITAL

R. T. M. DUNPHY—10 Operations

TEMPLE UNIVERSITY HOSPITAL

WALTER I. ILLIE and staff—1 Operative and dry clinic

U. S. NAVAL HOSPITAL

T. S. MORING, C. W. STELLIE and I. HARBERT—9 Operative and dry clinic

WILLS HOSPITAL

J. M. CRIKOR, F. C. PARKER and T. A. O'BRIEN—2 Operative and dry clinic

Friday

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

L. C. FETTER and staff—2 Dry clinic

HAHNEMANN HOSPITAL

FREDERICK C. FETTER and staff—2 Operations

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

FRANCIS HEED ADLER—2 Operative and dry clinic

JEFFERSON HOSPITAL

C. I. C. SWANNO—2 Operative and dry clinic

PENNSYLVANIA HOSPITAL

A. C. LAWELL—2 Functus clinic

PRISBYTARIAN HOSPITAL

H. M. LANCSON—2 30 Operative and dry clinic

PROTESTANT EPISCOPAL HOSPITAL

ANDREW F. WY—2 Operative and dry clinic

ST. CHRISTOPHER'S HOSPITAL

J. B. FELDMAN—Squint clinic

ST. JOSEPH'S HOSPITAL

THOMAS O. PRINN—4 Operative and dry clinic

TEMPLE UNIVERSITY HOSPITAL

WALTER I. ILLIE and staff—1 Operative and dry clinic

WILLS HOSPITAL

LOUIS LEHRFELD, W. S. REESE and C. R. MULLEN—2 Operative and dry clinic

WOMEN'S HOMOPATHIC HOSPITAL

C. J. V. FRIS—2 Operative and dry clinic

SURGERY

GYNECOLOGY AND OBSTETRICS

An International Magazine, Published Monthly

VOLUME 69

OCTOBER, 1939

NUMBER 4

MALIGNANT LESIONS OF THE THYROID GLAND

A Review of 774 Cases

JOHN deJ PEMBERTON, M D, F A C S, Rochester, Minnesota

IN THE past quarter of a century, progress in our knowledge of malignant tumor of the thyroid gland has fundamentally changed our conception of the disease and its treatment. Formerly in no organ other than the thyroid gland did the pathologist experience as much difficulty in distinguishing the microscopic picture of early malignant changes from certain benign changes incident to functional activity. For the most part, his errors were those of omission, that is, failure to recognize malignant changes when present. This lack of ability on the part of the pathologist, more than any other factor, served to retard progress in our knowledge of malignant lesions of the thyroid gland. Since the recognition of the disease by both the clinician and the pathologist formerly was limited, for the most part, to the advanced cases with large, fixed, infiltrating tumors associated with obstruction, pain, hoarseness, and other symptoms, it follows that the then prevailing conception of malignant tumor of the thyroid gland was based on the study of the disease in its late stage.

Curiously enough, a large share of our present knowledge of the subject has been ac-

quired as a by product during the process of developing surgery of benign tumors of the thyroid gland, rather than through any conscious effort toward a direct attack on the problem itself. As the operations for goiter increased in number and the pathologic changes in the goitrous glands became better understood, it was learned that of the nodular goiters removed for supposedly benign tumors, a small percentage showed malignant changes. In this manner proof was obtained of the obvious fact that carcinoma of the thyroid gland, as well as carcinoma elsewhere, has an early stage, and, if the tumor is then excised, the disease can be cured in a large percentage of cases. As a consequence of the alertness of the pathologists and the added experience in the treatment of these patients, our conception of this disease has been radically revised.

The basis for this review is a series of 774 patients with malignant lesions of the thyroid gland seen in The Mayo Clinic during the period 1907 to 1937, inclusive. Papers relating to different phases of the problem based on part of this material have been previously published (1, 2, 4, 10, 12-16, 20). In 517 of these cases the diagnosis was established by microscopic examination of the specimen of the tumor removed at operation (Table I), and in the remainder, 257, the clinical diag-

From the Division of Surgery The Mayo Clinic
Read before the meeting of the Third International Goiter Conference Washington District of Columbia September 12 to 14, 1938

nosis of inoperable carcinoma was so unmistakably clear as to require no biopsy for confirmation. In a paper, "Treatment of carcinoma of the thyroid gland" written in 1934 (15), I stated that a study of the ratio of malignant tumors to operative cases of goiter each year does not show any definite trend, except a moderate increase during the years since 1928. This increase I interpreted as relative, rather than actual and attributed it to the tendency of patients to defer operation because of the economic depression.

Recently I determined the yearly ratio of operative cases of malignant thyroid tumors to the operative cases of benign nodular goiters for the period 1910 to 1937 inclusive. Viewed in their entirety, the figures presented a different picture. While the yearly ratios varied widely, there was no noticeable trend during the first 10 year period, but since then the figures show a definite and progressive increase in the proportion of malignant to benign tumors. This increase becomes more apparent when averages for 5 year periods are compared. Thus since 1919 the ratio of malignant tumors to benign tumors has risen from 2 per cent to 4.9 per cent.

From these figures alone one is not justified in drawing the seemingly logical conclusion that the incidence of malignant lesions of the thyroid gland is increasing, for there is another factor which may affect these ratios, that is greater ability of the pathologist to distinguish between early malignant and benign tumors. Therefore it is probable that in recent years the relative number of patients with malignant thyroid tumors admitted to the clinic is not materially greater than that of former years but that we are now recognizing more of the early cases.

Of the 774 patients, 282 were males and 492 were females, a ratio of 1:1.74. For the same period the sex ratio of males to females for all benign nodular goiters exclusive of exophthalmic goiters was 1:5.07. The age incidence in this series corresponds for the most part to that of carcinoma situated elsewhere in the body, 69.6 per cent of the patients being within the age period 40 to 70 years, 52.8 years representing the mean age for males and 48.1 years for females (Fig. 1).

However, our experience would indicate that in children carcinoma shows a greater predilection for the thyroid gland than is generally appreciated. Four of our patients were less than 10 years of age, all girls, the youngest 7 years, and in the second decade of life there were 13 patients, 8 girls and 5 boys. Thus these 17 patients under 20 years of age constituted 2.2 per cent of our series. This finding is of immense practical significance, especially since the opinion prevails among many clinicians and surgeons that operation for the removal of thyroid nodules in children should be deferred until the patient has reached the age of 25 or 30 years. However, in my experience palpable benign tumors of the thyroid gland in children aged 14 years or less are rare, and I am in full accord with the warning of Kennedy (12) that any mass in the thyroid glands of children, however innocent appearing clinically, should be suspected of having malignant qualities. Of the malignant tumors in children a great percentage are of the papillary or malignant adenomatous type, of a low grade of malignancy, and therefore are in their early stages, peculiarly amenable to treatment by surgery and irradiation.

For many years it has been generally recognized by all writers on the subject that the presence of a pre-existing benign adenoma of the thyroid gland is the most important known etiological factor in the development of thyroid carcinoma. The large incidence of malignant tumor that arises from fetal adenomas and the frequent pathological observation of definitely encapsulated degenerating adenomas in parts of which malignant changes are taking place are conclusive evidence of this etiological relationship.

However, my own experience leads me to question the accuracy of the estimations of previous writers including myself who have placed the incidence from 80 to 93 per cent. My figure of 87 per cent was calculated on a combined pathological and clinical basis and I am confident now that this method is subject to many errors of interpretation. Because of the very low grade of malignancy in many of the cases, a malignant tumor may exist for a year or more without any clearly appre-

able growth, and because of the history of the presence of the tumor the error of ascribing its origin to a benign adenoma could be easily made from the record of the case. Likewise, in other cases the history may show that the patient has had a nodular goiter of many years' duration before operation, and operation may reveal that the malignant lesion developed in the non goitrous portion of the gland. Thus, unless the facts are all clearly stated in the record, a reviewer can easily be misled as regards the relationship of the carcinoma to the pre-existing adenoma. It is therefore my belief that an accurate determination of the incidence is not possible from the review of records, and accordingly no attempt to do so was made in this series.

However, the fact that a large proportion of carcinomas of the thyroid gland originate in a pre-existent benign tumor is of immense practical importance in the prevention and treatment of malignant lesions of the thyroid gland. Obviously the prevention of endemic goiter will markedly reduce the incidence of carcinoma of the thyroid gland, and since there are no clinical signs or symptoms to indicate early malignant transformation, the potentiality of malignancy of every discrete thyroid tumor must be considered.

HYPERTHYROIDISM

Because the thyroid gland of patients with hyperthyroidism (exophthalmic goiter and hyperfunctioning adenomatous goiter) commonly shows hyperplastic changes, the possible etiological relation of hyperthyroidism to malignant lesions of the thyroid gland was

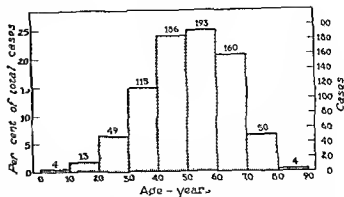


Fig. 1. Age distribution of patients with malignant tumors of the thyroid—774 cases

investigated. In the series, basal metabolic determinations had been made in 245 patients in 132, or 53.9 per cent, the rate was normal, that is, from -9 to $+9$ per cent, in 31, or 12.6 per cent, the rate was below normal, that is, -10 to -30 per cent, and in 82, or 33.5 per cent, the rate was above normal, $+10$ to $+80$ per cent. When the basal metabolic rates were checked according to the type of malignant lesion it was found that the percentage of rates above normal was as follows: cases of papillary adenocarcinoma, 28.2, adenocarcinoma in adenoma, 38.4, and diffuse adenocarcinoma, 32.9. In variability the rates in this series are comparable to those I previously reported and from them no clues can be derived to suggest that the hyperplastic change associated with hyperthyroidism is an etiological factor in malignant lesions of the thyroid gland. Furthermore, it is uncommon for malignant lesions to develop in the hyperplastic thyroid gland of exophthalmic goiter. This association was encountered in 10 pa-

TABLE I.—PATHOLOGICAL TYPE AND GRADE OF MALIGNANCY IN 517 CASES IN WHICH HISTOLOGICAL EXAMINATION WAS MADE—1907-1937

Pathological type	Total		Grade of malignancy				
	Number	Per cent	1	2	3	4	Not stated
Papillary carcinoma	155	30.0	97	54	1	0	3
Carcinoma in adenoma	197	38.0	46	99	32	18	2
Adenocarcinoma diffuse	157	30.4	4	38	35	65	15
Epithelioma	4	0.8	0	0	3	1	0
Sarcoma	4	0.8	0	0	1	2	1
Total	517	100	147	191	72	86	21
Per cent of total graded cases (496)			29.6	38.5	14.5	17.3	



Fig. 4 Adenocarcinoma in adenoma (malignant adenoma)

the neighboring tissues. In spite of the low grade of malignancy these tumors when non-encapsulated exhibit a predilection for invading the lymph nodes and spread to involve a cervical lymph node or a chain of nodes. Frequently the involved lymph nodes become manifest in the absence of any palpable nodule of the thyroid gland and at operation for the removal of the nodes the primary tumor may be overlooked if the character of the cancerous nodes is not recognized. Even in neglected or recurrent cases in which the condition is inoperable because of the fixation of the growth rarely does metastasis extend beyond the mediastinum or the lungs. There is a close similarity in biological characteristics between this type of carcinoma of the thyroid gland and the papillary adenocarcinoma of the ovary to which I previously called attention.

Frequently malignant tumors of thyroid structure are found in the neck separated from the thyroid gland and lateral to it. Since in my experience all have been papillary adenocarcinomas and since I have previously presented my views regarding their probable origin from the thyroid gland I do not believe that they should be considered a separate group. They are therefore included with the other papillary adenocarcinomas.

Of the 517 cases in which a pathological examination was made papillary adenocarcinoma was found in 155 or 30 per cent. In 117, or 75 per cent, of the 155 cases of

papillary adenocarcinoma resection of the tumor was carried out, and in the remaining 38 cases or 25 per cent, the growth was inoperable and only a specimen was removed.

Adenocarcinoma in adenoma (malignant adenoma) As the term implies this type of tumor arises from malignant transformation of benign adenomas, for the most part from 'fetal' adenomas (Fig. 4). Commonly the tumor is single, but it may be multiple. Its structure is not uniform but varies within wide limits. In some cases the structure of the follicles is preserved in whole or in part; in others the follicular arrangement is completely lost so that the tumor presents a picture of branching columns of undifferentiated cells. For the most part these tumors are of a low grade of malignancy, grades 1 and 2, but occasionally tumors of grades 3 and 4 occur. Unlike papillary adenocarcinoma tumors of this type do not spread by way of the lymph vessels until the capsule of the tumor is invaded but on the contrary tend to metastasize early by way of the blood stream. This feature sometimes can be demonstrated at operation by the presence of sizable masses of carcinomatous tissue in the veins about the thyroid gland. Since the invasion of the capsule does not occur until late and since the consistency and relative fixation of the tumor are not materially altered until its capsule is invaded the malignant changes in these tumors are commonly not suspected before operation unless distant metastasis has been discovered. If the history reveals that there has been recent growth of the tumor this then may be the only clinical feature to excite suspicion that the tumor may be malignant. There were 197 patients with adenocarcinoma in adenoma which represented 38 per cent of the 517 comprising the series. Of the 197 patients with carcinoma in adenoma 191 or 97 per cent were subjected to partial thyroidectomy and in only 6 or 3 per cent was the process considered inoperable.

Diffuse adenocarcinoma This type of tumor may arise within a pre-existing benign nodule or from a non-goitrous gland. It presents as wide a variety of cellular changes and histological patterns as tumors of similar

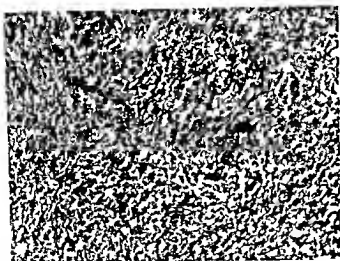


Fig 5 Diffuse adenocarcinoma

grades of malignancy situated elsewhere (Fig 5). In the higher grades of malignancy, in which the follicular structure is completely lost, the arrangement of the rapidly growing cells, small, round, spindle shaped, or giant, may simulate the picture of sarcoma. Not only have tumors of this type been mistaken for sarcomas, but pathologists confronted with two dissimilar pictures in the same tumor, one resembling sarcoma and the other carcinoma, have considered the process a compound one and have termed it "carcinoma sarcomatode." The acute fulminating malignant growths of the thyroid gland are represented by this type. Metastasis occurs by way of the lymph vessels, or blood stream, or both. Because these tumors are for the most part more highly malignant than the tumors of the first two groups, their tendency to invade neighboring structures is more pronounced, and they are therefore more easily recognized clinically. There were 157 patients (30.4 per cent) with such tumors and resection was carried out in only 74, or 47 per cent.

Squamous epithelioma This type of tumor of the thyroid gland is exceedingly rare and whereas its origin is commonly ascribed to extensions from the esophagus, trachea or thyroglossal duct, Broders (5) considers that the tumor may arise directly from the thyroid gland by metaplasia of the epithelium. Primary epithelioma of the thyroid gland occurred in 4 cases, in all of which the patients died within a year of the operation.

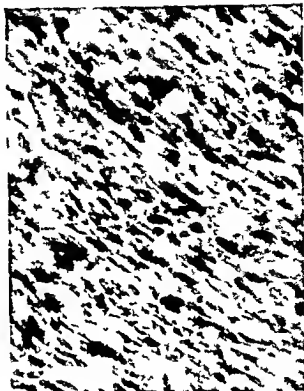


Fig 6 Sarcoma of the thyroid

Sarcoma Because of the close microscopic resemblance of certain highly malignant carcinomas to sarcomas, pathologists have questioned whether sarcoma ever originates in the thyroid gland. Although the incidence as reported in the literature is perhaps far too high, sarcoma of the thyroid gland (Fig 6) has been positively diagnosed in 4 cases, 1 of which was of primary osteogenic type. All 4 patients died within a year of operation (6).

METASTASIS

Mention has already been made of the routes by which the different types of thyroid tumor metastasize. A statistical study was undertaken to determine the sites of metastasis according to the type of malignant tumor in 112 cases in which metastasis was noted, in many instances on patients' readmissions subsequent to operation. Results are pictured in Figure 7.¹ The predilection of papillary adenocarcinoma to spread to the cervical lymph nodes, as shown in Figure 7, is in keeping with our clinical observations.

¹Since some cases showed metastases to more than one location, the total number of metastases is greater than the total number of cases in which metastases were noted.

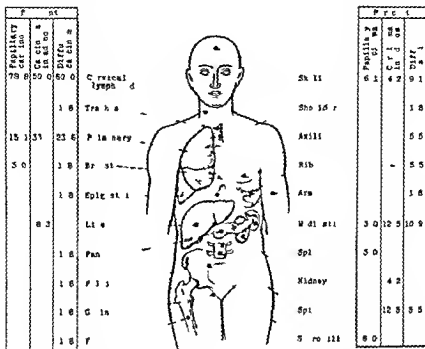


Fig. 7. Percentage distribution of metastases of malignant tumors of the thyroid by site of metastasis and type of tumor

Symptoms

As aforementioned there are no signs or symptoms of early malignant tumor of the thyroid gland. However as the disease progresses and before it reaches the inoperable stage there are in many cases findings which may lead to a tentative if not absolute diagnosis. The history of recent increase in the size of a pre-existing adenoma, the recent development of a tumor of the thyroid gland the complaint of a sense of pressure in the neck, often out of proportion to the size of the tumor and the finding on palpation of a thyroid tumor that is firmer, more nodular and relatively more firmly fixed than that usually encountered in benign goiters are all suggestive evidence. While the contour of most benign enlargements of the gland conforms in general to the shape of its expanding bed it is not uncommon in some cases of malignant tumor of the thyroid gland before actual invasion through its capsule has occurred to find part of the tumor pushing through a fascial compartment to present itself as a firm nodular projection. Thus unusual irregular

ity in the contour of the tumor together with its increased firmness may constitute strong evidence of its malignant nature. Actual invasion of the malignant tumor through the thyroid capsule is commonly manifested by definite limitation of movement of the tumor, as well as by increased firmness. However, in cases in which the penetration of the cancer is limited to the posterior and mesial aspects of the gland palpation may reveal no change in its mobility or consistency to suggest malignant changes. Yet in many cases of posterior invasion the inferior laryngeal nerve may be encroached on sometimes without actual invasion and the condition becomes manifest by a hoarse brassy voice together with fixation of the vocal cord in the cadaveric position. While a benign thyroid tumor may occasionally produce by pressure interference with the function of the cord it is extremely rare for such a tumor to produce the combination of hoarseness and fixation of the cord. Thus irrespective of the size, contour or consistency of the thyroid tumor hoarseness and a fixed vocal cord in the absence of syphilis

aortic aneurism or mitral stenosis, are almost pathognomonic of malignancy

In the differential diagnosis the lesions most likely to be mistaken for malignant tumors of the thyroid gland are diffuse chronic or subacute thyroiditis, of the Riedel or Hashimoto variety, and hemorrhagic adenoma. Although in most instances one can be reasonably certain of the diagnosis when confronted with one of these conditions, the fact remains that the malignant character of any enlargement of the thyroid gland cannot be definitely excluded without surgical exploration. Thus in the review of the clinical diagnoses in the surgical cases, it was found that in 60 per cent the presence of a malignant tumor was not suspected, but was discovered at the operation or during the pathologist's examination of the tissue. Furthermore, of this group in which the diagnosis was not suspected, 8 per cent showed an advanced inoperable condition, indicating that even in the advanced cases there may be no clinical finding on which the diagnosis of malignant tumor can be based. On the other hand, of the group of cases in which the clinical diagnosis of malignant tumor was definitely made, which constitutes 23 per cent of the series, 42 per cent were found operable, and in the group in which the diagnosis of malignant tumor was suspected, which represents 18 per cent of the series, 62 per cent were operable lesions. It seems apparent, therefore, that in a fair proportion of cases in which the diagnosis of malignant tumor of the thyroid gland can be made from clinical examination, the tumor will be found to be resectable.

OPERABILITY

Of the 774 patients with malignant lesions of the thyroid gland seen in The Mayo Clinic from January, 1907, to January, 1938, operative procedures were carried out on 509¹. Of this group, the tumor was extirpated in 384 and in the 125 remaining, biopsy of the gland or metastatic masses, excision of involved cervical nodes, tracheotomy for obstruction or a combination of these, was performed. The 384 patients who had a partial thyroidectomy represent 49.6 per cent of all patients

¹ Eight patients who had biopsy elsewhere were not included

with carcinoma of the thyroid gland seen during this period

As I have previously stated, operability of carcinoma of the thyroid gland depends on the extent of the local invasion of the primary lesion and on the absence of distant metastasis. In the absence of distant metastasis, the relative fixation of the tumor is the most important feature to be considered in determining operability. Tumors which are completely fixed to all the contiguous structures should not be operated on, for it is obvious that the risk involved in extirpating the tumor is out of proportion to the amount of benefit that one could hope to obtain. However, if the mobility is limited in such a way as to suggest that the carcinoma has perforated the capsule of the gland at one place only, then exploration is justifiable, for frequently in such instances the tumor can be removed in its entirety. Even when the tumor cannot be removed completely, radium can be directly applied to the small fragment of carcinoma that is left attached. This procedure is especially applicable in cases of extensive carcinoma of the papillary adenomatous type, in this series there are several patients who have lived for many years in good health and without evidence of recurrence of the malignant tumor following partial removal of the primary lesion, supplemented by irradiation. The significance of carcinomatous involvement of the cervical lymph nodes, as regards operability, varies according to the type of malignant lesion. Unless the type is the low grade papillary adenocarcinoma, I consider it very doubtful whether radical removal of the carcinomatous process is ever justifiable. However, if the malignant lesion is of the papillary adenocarcinomatous type, metastasis to the cervical nodes does not constitute a contra indication to radical removal of the primary lesion together with the involved nodes. On the contrary, if the primary lesion is operable, operation can often be undertaken at small hazard and with good prospects of effecting cure.

Among the factors that influence operability, aside from the fixation of the growth and the type of malignant lesion, the most important is the grade of malignancy. In

this series the grade was determined in 496 cases. Of the 338 cases of grades 1 and 2 26.4 or 84 per cent were operable, of the 72 cases of grade 3 52 or 72.2 per cent, were operable, and of the 86 cases of grade 4 46, or 53.5 per cent were operable.

The appearance of enlarged (carcinomatous) cervical nodes months or years after removal of a malignant thyroid tumor in the absence of a recurrent tumor in the thyroid gland has not the same prognostic significance as the occurrence of enlarged nodes following operation for malignant lesions situated elsewhere. Here it indicates that the primary lesion was of the papillary adenocarcinomatous type and if the involved nodes are confined to the neck surgical removal offers a reasonable chance of cure.

While biologically the behavior of papillary adenocarcinoma of the thyroid gland does not differ basically from that of cancer elsewhere it is important that the surgeon recognize two characteristic features of the former: its tendency to spread by lymphatics to regional nodes and its relatively low grade of malignancy. In the practice of a surgeon it is seldom that a radical operation is indicated for the removal of recurrence or metastatic spread of a malignant lesion which has developed following an operation for the removal of a primary growth. In most such instances the surgeon correctly recognizes that the disease is well beyond control and wisely resorts to roentgen therapy as the best agency for checking its progress. However, when the primary lesion is a papillary adenocarcinoma of the thyroid gland in many instances in which local recurrence and extensions of the lesion into the cervical nodes occur the condition may still be amenable to surgery.

Theoretically the surgical procedure in malignant lesions of the thyroid gland should consist in wide removal of the primary growth together with the regional lymphatic structures, but experience has proved that extirpation of the cervical nodes unless there are reasons to suspect that they are actually involved is seldom necessary in order to obtain the greatest benefits. The latter part of this statement, because it is at variance with the basic principles on which rests the surgical

treatment of malignant lesions in general, deserves a word of explanation. Carcinoma of the thyroid gland with the possible exception of the papillary type seldom spreads by way of the lymph vessels until it has penetrated the capsule of the gland. If the growth is of the papillary type and has invaded the capsule exploration of the cervical nodes on the affected side should be carried out and the nodes extirpated if found enlarged. Growths of high grade of malignancy which have invaded the capsule are commonly inoperable because of extensive fixation, and hence removal of as much of the primary lesion as possible followed by irradiation will accomplish as much as a more radical operation including removal of the cervical lymph nodes.

Commonly the operable carcinoma is completely encapsulated, which accounts for the fact that in so large a percentage of cases the malignant nature of the tumor is not suspected before operation. I consider that wide removal of these tumors is a sufficiently radical procedure. If the carcinoma is not definitely encapsulated, the operative procedure calls for total removal of the affected lobe. It is only for a very limited group of bilateral infiltrating carcinomas that removal of the entire thyroid gland is indicated.

If the carcinoma is not definitely encapsulated a large rubber drainage tube is left in the cavity so that later (12 to 48 hours) radium may be inserted directly in the wound. Subsequently in all cases after the wound has partially healed topical application of radium and treatment with roentgen rays are given.

MORTALITY

The operative hazard in malignant tumors of the thyroid gland is dependent for the most part on the extent of invasion of the tumor as well as the nature of the structures secondarily invaded. Among the 384 patients who underwent partial thyroidectomy 7 died in the hospital, a mortality rate of 1.8 per cent. Among the 125 remaining patients on whom an operation was performed including biopsy of the gland or metastatic masses, excision of involved cervical lymph nodes or tracheotomy for obstruction, 5 died in the hospital, a mortality rate of 4.0 per cent.

TABLE II—SURVIVAL AFTER TREATMENT ACCORDING TO TREATMENT

Treatment	Patients treated*	Patients traced	Lived 5 or more years after treatment		Patients treated*	Patients traced	Lived 5 or more years after treatment		Patients treated*	Patients traced	Lived 10 or more years after treatment	
			Patients	Traced cases— %			Patients*	Traced cases— %			Patients	Traced cases— %
Thyroidectomy only	109	108	75	69.4	106	105	66	62.0	96	95	51	53.7
Thyroidectomy with irradiation	216	215	183	80.0	222	221	161	72.0	150	157	94	59.9
Irradiation only	159	156	41	20.1	130	138	12	8.2	91	90	13	14.4

*Inquiry as of January 1, 1938. The 5 year group comprises the patients treated 5 or more years prior to the time of inquiry; i.e., 1933 or earlier; the 10 year group comprises those treated in 1927 or earlier.

INOPERABLE CARCINOMA OF THE THYROID GLAND

In this series, irradiation therapy has been employed in the treatment of the inoperable cases and as an adjunct in many of the operable cases. Its value in reducing the size of the lesion and holding in abeyance inoperable and recurrent masses of malignant thyroid tumor has been long recognized. That it has also a definite value as a supplemental therapy in the operable cases is indicated by the fact that the survival rates are materially higher in the group of patients who were treated by thyroidectomy and irradiation than in the group who were treated by thyroidectomy alone.

RESULTS OF TREATMENT

As revealed by study of Tables II, III, and IV¹ the percentage of patients with malignant tumors of the thyroid gland who have lived 3, 5, and 10 years or more after treatment is gratifyingly high, and to those whose conception of the disease is based on the accepted teachings of 20 years ago, the percentage is amazing, if not unbelievable. Thus, of the patients who underwent thyroidectomy with or without irradiation treatment the survival rates for 3, 5, and 10 years or more were 77, 70, and 58 per cent, respectively. Of the patients who were treated by

irradiation alone, the survival rates for 3, 5, and 10 years or more were 29.1, 23.2, and 14.4 per cent, respectively (Table II). These survival rates should not be misinterpreted as indicating cures, that is, that these patients are free of a malignant tumor of the thyroid gland. They mean that the patients have lived the number of years indicated. As I previously pointed out, it is known that some of the patients who have lived 5 years or longer have local recurrence or persistence of the malignant lesion, the exact percentage is not known.

In order to determine what factors were of influence on the prognosis of treated cases of malignant lesions of the thyroid gland, the survival rates were calculated according to type of lesion and grade of malignancy and according to the pre-operative clinical diagnosis. As has been pointed out, the type of malignant lesion is of great importance in the operability, as well as in the method of surgical management that should be employed in cases of malignant lesion of the thyroid gland. The grouping of cases according to the pathological type of malignant lesion is of equal value in estimating the result of treatment, as shown in Table III. Thus, in the operable group, and to a lesser degree in the inoperable group, papillary carcinoma is the most favorable in its prognosis, carcinoma in adenoma is the next most favorable, while diffuse carcinoma is the most serious.

When the survival rates of the patients with carcinoma of the thyroid gland were determined according to the grading of malignancy, the results showed in unmistakable clearness what Broders (3) has previously demon-

¹The survival tables presented in this paper as the figures show are based on a very high proportion of traced cases. Prior to 1936 tables giving survival rates for malignant lesions of the thyroid gland were based on a considerably smaller proportion of traced cases, and it was generally assumed that untraced patients were probably dead at the time of inquiry. In recent years the Division of Biometry and Medical Statistics of the Mayo Clinic has undertaken the responsibility of making the calculation of survival rates and in the connection an exhaustive effort has been made to trace the living up to a complete as possible. As a result the proportion of traced cases has materially increased. Owing largely to this fact the survival figures in this paper vary in certain respects from figures in earlier papers.

TABLE III—SURVIVAL AFTER TREATMENT ACCORDING TO PATHOLOGICAL TYPE

Surgical procedure pathologic type	Patient treated	Patient traced	Lived 3 or more years after treatment		Patient treated	Patient traced	Lived 5 or more years after treatment		Patient treated	Patient traced	Lived 10 or more years after treatment	
			Female	Male			Female	Male			Female	Male
Thyroidectomy Papillary carcinoma	10	100	06	06	07	06	80	07	7	60	57	85
Carcinoma Ductal carcinoma	122	121	134	284	161	161	114	74	55	134	75	56
Carcinoma Ductal carcinoma	60	60	33	473	65	65	24	360	43	43	3	71
Benign Papillary carcinoma	3	3	12	260	13	27	12	63			7	350
Carcinoma Ductal carcinoma	4	4	1	150	4	4	1	15	3	3		
Ductal carcinoma	60	60	6	3	67	67	1	164	43	41	3	6

TABLE IV.—SURVIVAL AFTER TREATMENT ACCORDING TO GRADE OF MALIGNANCY

T t m t a l g a d		P a t t e d	P a t t e d	L i d e m r e y s f r t a m t		P a t t e d	P a t t e d	L i d e m r e y s f r t a m t		P a t t e d	P a t t e d	L i d e m r e y s f r t a m t	
				P a t t	T r a c e d			P a t t	T r a c e d			P a t t	T r a c e d
Th y d e c t m	th w i t h												
G d		100	5	10	96	4	13	96	93	8	78	63	88
t d		46	45	5	86	123	37	94	750	100	07	67	60
a l 3		43	48	1	65	45	45	3	31	33	35	4	4
t l 4		4	4	4	95	4	41	4	97	3	3		3
l r d t	l												
G a l		6	5	11	733	15	44	9	543	1	1		20
G a d					545	9	9	9	474	3	15	6	4
C a d 3			0	4	100			3	3	6	6		67
G a d 4		0	0	4	18	13	8		71	5	5		

strated in cases of cancer of the lip, skin and rectum that a poor prognosis is in direct proportion to the microscopic grade of malignancy and a favorable prognosis is in inverse proportion to the microscopic grade of malignancy (Table IV).

Since a positive clinical diagnosis of malignant tumor of the thyroid gland is commonly directly related to the degree of fixation of the tumor by invasion into surrounding tissues, it has been stated by many writers that in cases in which a positive clinical diagnosis is possible, treatment is of no avail. This view is not in accord with my experience since the percentage survival rates of the operable

cases for 3, 5 and 10 years or more are 31, 22.5 and 16 respectively. However, it can be stated that the prognosis of thyroid carcinoma is in inverse proportion to the certainty of the clinical diagnosis (Fig. 8).

Therefore when these 3 factors are considered it will be seen from the foregoing tables that the outlook of thyroidectomy and irradiation is most favorable in papillary adenocarcinoma of grade 1, the malignant nature of which is not suspected clinically, and conversely, the prognosis is least favorable in diffuse adenocarcinoma of grade 4 the malignant nature of which is diagnosed before operation (Table IV).

SUMMARY

A series of 774 cases of malignant lesions of the thyroid gland was reviewed, in 517 the diagnosis was established by microscopic examination of a specimen and in 257 the clinical diagnosis of inoperable carcinoma required no biopsy for confirmation.

The age incidence in carcinoma of the thyroid gland corresponds to that of carcinoma situated elsewhere in the body, although its occurrence in children is more common than generally suspected. Therefore any mass in the thyroid gland in children should be suspected of having malignant qualities. The sex incidence shows a ratio of 1 male to 1.74 females, whereas the ratio in benign nodular goiter is 1 to 5.07.

A large percentage of malignant tumors of the thyroid gland originates in a benign adenoma, which knowledge is of great importance in the prevention and treatment of malignant lesions of the thyroid.

The basal metabolic rates of patients with a malignant tumor of the thyroid gland are not constant and the co-existent benign tissue is probably what determines the patient's rate. The estimation of the basal metabolic rate is therefore of no aid as a diagnostic measure in determining malignant changes.

Analysis of the grade of malignancy of tumors shows that 68 per cent are of low grade, grade 1 or 2 on a basis of 1 to 4, which may account for the difficulty in recognizing them in the past. The histological criteria of malignant tumors of the thyroid gland are the same as those of malignant tumors elsewhere in the body, that is, anaplasia or dedifferentiation.

That the pathologist has become increasingly alert in detecting malignant tumors of the thyroid gland is shown by the fact that there has been a steady rise in the percentage of malignant tumors discovered in patients operated on for thyroid tumors considered clinically benign.

Malignant tumors of the thyroid gland are classified as follows: (1) papillary adenocarcinoma, (2) adenocarcinoma in adenoma (malignant adenoma), (3) diffuse adenocarcinoma, (4) epithelioma, and (5) sarcoma. Because of important biological differences all adeno-

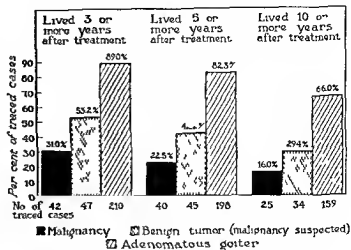


Fig 8 Percentage of patients who survived for 3, 5, or 10 or more years after thyroidectomy classified by clinical diagnosis.

carcinomas of the thyroid gland fall readily into one of three groups. The distinguishing clinical features of papillary adenocarcinoma are the low grade of malignancy, marked radiosensitivity, and the tendency for the disease to spread to regional lymph nodes where it may be confined without further dissemination for many years. Therefore, metastasis to these structures is not necessarily a criterion of inoperability in this type, for radical removal of the primary lesion and the involved nodes, in conjunction with post-operative irradiation, offers a good chance for cure.

The essential clinical features of adenocarcinoma in adenoma are commonly the low grade of malignancy and the tendency to early dissemination of the carcinoma by way of the blood stream. Since lymph vessels are not involved until after the carcinoma has invaded the capsule, the presence of cervical metastasis in this type has a far graver prognostic significance than in papillary adenocarcinoma.

The diffuse adenocarcinomas of the thyroid gland are commonly of higher grades of malignancy than the preceding types and behave as diffuse adenocarcinomas situated elsewhere. Both squamous epithelioma and sarcoma of the thyroid gland are rare and very malignant.

A statistical study was made to determine the sites of metastases according to type of malignant lesion in 112 cases showing metas-

tases the cervical lymph nodes were the most common site and the lungs next.

There are no signs or symptoms of early carcinoma of the thyroid gland. In the moderately advanced cases recent growth sense of pressure and a tumor that is firmer and more nodular than that usually encountered in benign adenomas are suggestive evidence. In 60 per cent of the surgical cases the malignancy of the tumor was not suspected before operation.

The fixation of the tumor and the type and grade of malignancy are the most important factors to be considered in determining the operability.

The most effective treatment for malignant tumors of the thyroid gland is the combination of operation and irradiation depending on the type and grade of malignancy. The rate of operability in these cases was 49.6 per cent.

The hospital mortality rate in cases of malignant tumor of the thyroid gland in which the patient underwent thyroidectomy was 1.8 per cent when the patient underwent biopsy alone or in association with tracheotomy the hospital mortality rate was 4 per cent.

The percentages of patients with malignant tumor of the thyroid gland who have lived 3, 5 and 10 years or more after treatment are 77, 70 and 58 respectively. The prognosis is most favorable in cases of papillary adenocarcinoma, less favorable in carcinoma in adenoma and still less favorable in diffuse carcinoma. The prognosis in cases of squamous cell epithelioma and sarcoma is extremely poor. When survivals were determined according to grading of malignancy it was found that the lower the grade of malignancy the more favorable the prognosis.

The statement by many writers that in cases in which a positive clinical diagnosis of

malignant tumor of the thyroid gland is possible treatment is of no avail, is not in accord with my observations.

REFERENCES

1. BALFOUR, D. C. Cancer of the thyroid gland. *Med Rec* 1894 846-850.
2. BOURVAC, H. H. Malignant tumors of the thyroid gland treated by operation, radium and roentgen rays. *Am J Roentgenol* 1927 19 502-508.
3. LUDWIG, J. C. The grading of cancer: its relationship to metastasis and prognosis. *Texas State J Med* 1933 20 520-523.
4. Idem. Surgical pathology of the thyroid gland. *Texas State J Med* 1936 31 60-615.
5. Idem. Personal communication to the author.
6. HEDGECOCK, C. and LEMBERTON, J. DEF. Primary osteogenic sarcoma of the thyroid gland: report of a case. *Surg Gynec & Obst* 1934 59 100-102.
7. CLIFF, H. M. and WARREN, SWILLING. The prognosis of thyroid cancer. *Surg Gynec & Obst* 1933 56 871-874.
8. DENHILL, T. I. Carcinoma of the thyroid gland. *Bull J Surg* 1931 19 93-5.
9. GRAHAM, ALLE. Malignant epithelial tumors of the thyroid: With special reference to invasion of blood vessels. *Surg Gynec & Obst* 1924 39 781.
10. HERBST, W. I. JR. Malignant tumors of the thyroid. *Ann Surg* 1924 79 488-494.
11. JOLL, C. A. Diseases of the thyroid gland. St. Louis: The C. V. Mosby Co. 1931.
12. KENNEDY, R. L. J. Carcinoma of the thyroid gland in children. *J Clin Med* 1935 7 631-650.
13. MAYO, C. W. Malignancy of the thyroid. *West J Surg* 1937 45 555-563.
14. LEMBERTON, J. DEF. Malignant disease of the thyroid gland: a clinical consideration. *Ann Surg* 1929 87 369-377.
15. Idem. Treatment of carcinoma of the thyroid gland. *Ann Surg* 1934 100 900-920.
16. LEMBERTON, J. DEF. and FRICKLE, R. L. Treatment of carcinoma of the thyroid gland. *Radiology* 1933 20 213-219.
17. SIMPSON, W. M. A clinical and pathological study of fifty five malignant neoplasms of the thyroid gland. *Ann Clin Med* 1921 4 443-667.
18. Idem. Three cases of thyroid metastasis to bones with a discussion as to the existence of the so-called benign metastasizing goiter. *Surg Gynec & Obst* 1926 42 7-507.
19. SMITH, C. H. Unpublished thesis.
20. WILSON, L. J. Malignant tumors of the thyroid. *Ann Surg* 1921 74 129-184.

ACUTE CHOLECYSTITIS

FRANK GLENN, M D, F A C S, New York, New York



TWENTY years ago the operative therapy of acute cholecystitis was delayed until the acute manifestations of the disease had subsided. The propriety of this treatment was then rarely questioned. Since that time an ever increasing number of surgeons have advocated early or immediate operation in acute cholecystitis. Walton, Miller, Heuer, Graham, Zininger, Mentzer, Stone and Owings, Judd and Phillips, and Smith are some of the authors whose experience contributes evidence in favor of this practice.

During the past year the literature has contained a greater number of articles in favor of early operation than opposed to it, however, there continues to be a great difference of opinion. It is the purpose of this paper again to present our experience with the early surgical treatment of acute cholecystitis—an experience which now comprises 219 consecutive cases subjected to operation in the early stages of the disease at the New York Hospital.

A review of the histories of the 219 patients treated in the early stages of acute cholecystitis is followed by a consideration of some of the controversial questions in the treatment of this disease.

The diagnosis "acute cholecystitis," in this group of cases is based upon both clinical and pathological findings. Clinically, it has been reached by careful evaluation of the patient's history, of his symptoms and of the signs elicited on physical examination. In the typical case a fairly long history of recurring episodes of biliary colic frequently precedes the onset of the acute attack, in some, however, there is no record of previous symptoms referable to the gall bladder. The pain is severe, located in the right upper quadrant, and may radiate to the shoulder or back. Nausea and vomiting frequently accompany the onset of pain in these cases.

The physical examination reveals marked tenderness and sometimes muscular rigidity in the right upper quadrant. The gall bladder may be palpable as a distended and tender mass. The patient looks ill, has a rapid pulse, some fever, and an elevated leucocyte count. Some patients whose attacks had lasted more than 24 hours showed a mild degree of jaundice.

Many of the 219 patients failed to present these characteristic manifestations of acute inflammatory disease. In some there was no fever, in others the leucocyte count was normal, and in still others the symptoms were not acute and, therefore, gave little hint of the seriousness and extent of the inflammatory process. In these atypical cases the final differential diagnosis was made on the basis of the findings at operation and in the pathologist's report.

At the operating table the surgeon finds a reddened, distended gall bladder with thick, edematous walls (see Fig 1). Besides one or more stones, the organ usually contains colorless bile or pus under pressure. On close inspection, areas of necrosis and gangrene of the wall may be noted, and in some a frank perforation will be found with inflammatory reaction around the gall bladder and adhesions to neighboring structures. Free perforation with general peritonitis also may occur. The favorite location for such perforation is shown in Figure 2. This avascular area in the presence of inflammation of the gall bladder and compression of its blood vessels is most likely to become gangrenous first. Necrosis of this portion of the gall bladder in the presence of an increased intracystic pressure results in perforation and escape of the contents of the organ into the abdominal cavity. On gross pathological examination an acutely inflamed viscus with congested walls and areas of necrosis is described; microscopically, the specimen shows polymorphonuclear infiltration with desquamation of the epithelium and necrosis of one or all layers of the gall bladder.



Fig. 1. Cholecystectomy for acute cholecystitis. The acutely inflamed gall bladder is readily enucleated from its bed by careful dissection thus preventing injury to the liver. Although this illustrates cholecystectomy being done by first dividing the cystic vessels and cystic duct, the procedure of first dissecting the gall bladder from above downward and then dividing the structures is employed by us even more frequently.

All of the 219 patients in this series fulfilled these clinical and pathological criteria for a diagnosis of acute cholecystitis and all were treated by early operation. Certain significant data have been derived from an analysis of these cases and they are presented in the accompanying chart and table.

A study Table I will show that the post-operative mortality is not unduly high after surgical treatment of acute cholecystitis unless perforation has taken place. Further it shows that two factors besides the extent of the inflammatory process have an influence on the outcome of the operation. The age of the patient at the time of operation is the first of these. It is evident that the mortality rate increases with age. The second factor is the

duration of symptoms referable to the gall bladder before the onset of the acute attack for which operation is undertaken. That this contributes to the fatal outcome of operation may be seen in the increase in the mortality when the symptoms had been present more than 1 year before operation. The gravest situation in this series of cases was encountered in patients over 50 years of age whose gall bladder had perforated during an acute attack of cholecystitis which followed more than 1 year of symptoms referable to the biliary tract. All of the deaths in perforation were in these patients.

In the chart the two columns represent respectively the total cases and the total deaths in the series of cases. The shaded portion of each column illustrates the proportion of the total cases of acute cholecystitis in which gangrene occurred; the solid black portion the incidence of perforation. Of particular signifi-



Fig. 2. The dissected acutely inflamed gall bladder. Dotted line indicates area where free perforation is most likely to occur.

cance in this chart is the fact that perforation occurred in 7.7 per cent of all cases and accounted for 27 per cent of the total deaths

OPERATIVE PROCEDURE

The operation of choice in acute cholecystitis is a cholecystectomy, for it interrupts the pathological process and prevents the development of its serious consequences. This operative procedure is contra indicated (1) in the presence of peritonitis following perforation of the gall bladder, (2) in conditions which make it difficult to identify the important structures in the biliary fossa. When the gall bladder is greatly distended and adherent, the adjacent viscera may be so distorted that anatomical relations are obscured, and there would be danger of inadvertently injuring the hepatic vessels or the common duct. (3) It is contra indicated in the presence of severe jaundice caused by obstruction of the common duct. (4) It is contra-indicated in patients whose general condition is so grave that a general anesthetic and prolonged operative procedure are not justified. In such cases a compromise must be sought in the form of surgical treatment which will tide the patient over the immediate crisis without adding to his burden.

On the basis of the principles enumerated, 200 of the 219 cases of acute cholecystitis were subjected to cholecystectomy and in 22 of these the common duct was explored. In 19 cases cholecystostomy was done. An exploration of the common duct rarely is necessary in acute cholecystitis. Especially is this true of the younger patients, for common duct stones are not often seen unless the disease has persisted for a considerable time. The indications for exploration in acute and chronic disease of the biliary tract are not identical. If there is marked jaundice or a history of recurring attacks of jaundice, and if a stone is palpated in the duct, then the common duct must be explored. The duct may be indurated and may appear to be distended without harboring a stone. An icteric index of 30 or less may be due to an inflammatory process in the biliary tree rather than to obstruction of the duct by a stone. In general it may be said that the common duct should not be explored in acute cholecystitis unless definitely indi-

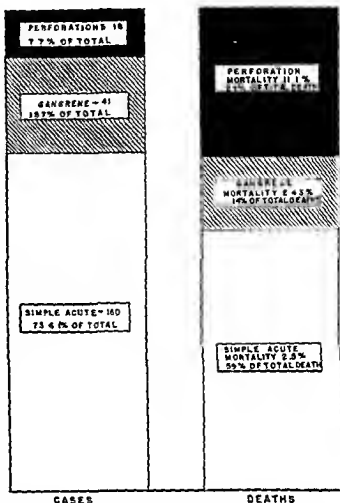


Fig. 3. Chart showing in left column comparative incidence of 3 types of cases of acute cholecystitis (219 cases); right column comparative mortality in 3 types of cases of acute cholecystitis (7 cases).

cated. In this series of cases it was explored 22 times and stones were found and removed in 9 cases.

ANALYSIS OF STUDY

In our experience the diagnosis of an acute process in the gall bladder is not difficult. However, the differential diagnosis of simple acute and complicated acute cholecystitis is very difficult, for the complications such as gangrene and perforation may occur in the presence of subsiding symptoms and normal temperature and leucocyte count. Only by planning an early surgical attack in acute cholecystitis can we hope to lower the mortality. Delay in operating tends only to increase the hazard of gangrene and perforation.

When the gall bladder is acutely inflamed, it is easily stripped from its bed without in-

TABLE I—ACUTE CHOLECYSTITIS

Extent of inflammatory process	Cases	Age	Duration of disease	Mortality—%
Total acute cholecystitis	219	Average age 45 years	Average duration 22 years	3.10
Acute without gangrene	150	Age less than 50 years 50 months to 50 years	Age less than 25 years 25 months to 25 years	2.5 1.8 0 4.4
Acute with gangrene	41	Age less than 50 years 50 months to 50 years	Age less than 25 years 25 months to 25 years	2.43 3.7 0 3.85
Acute with gangrene and perforation	8	Age less than 50 years 50 months to 50 years	Age less than 25 years 25 months to 25 years	12.5 0 0 2.2

juring the liver and other neighboring structures (see Fig. 1). The difficulties of the operation for acute cholecystitis are encountered in cases which have been permitted to proceed to gangrene and perforation or in those cases in which the disease has subsided leaving the patient with an extracholecystic abscess or adhesions.

It is repeatedly stated in the literature that the removal of an acutely inflamed gall bladder is likely to be attended by the extension of the infection. This danger in our opinion is greater when an extracholecystic abscess or a localized peritonitis exists. It is true that streptococcal infection of the biliary tract is not uncommon also that these infections tend to spread when disturbed by operation. When great care is used not to spread the infection during operation it has been demonstrated that fulminating streptococcal infections after cholecystectomy do not occur. Furthermore contamination of the operative field with the contents of an acutely inflamed gall bladder does not invariably lead to extensive peritonitis. Drainage is applied in all cases at operation.

The postoperative course in patients under 50 years of age with simple acute cholecystitis is almost invariably uneventful. The older patients obviously are more likely to suffer postoperative complications. However, if time is taken before operation to counteract conditions such as dehydration, cardiac decompensation, etc., and the operation is planned so that it places little additional burden on the patient, the incidence of postoper-

ative complications will be no higher during the acute stage of cholecystitis than in chronic affections of the gall bladder. It would seem that the danger of operating in uncomplicated acute cholecystitis is overemphasized. It is we believe distinctly less than the danger of gangrene and perforation which occur in a fair percentage of cases if a waiting policy is pursued.

The mortality rate was 3.10 per cent for the 219 cases irrespective of pathology, age or other factors. Compared to the mortality rate for all operations for non-malignant disease of the biliary tract which includes a series of 90 cases this is a favorable figure. It must be stated here that the operations were performed not by one but by twelve or more general surgeons.

SUMMARY

A review of the case histories of the 219 patients with acute cholecystitis who have been treated at the New York Hospital in the past 6 years is given.

It is shown by this series of cases that early operation may not be difficult nor attended by a greater incidence of complications nor a higher mortality rate than that ordinarily reported for series of operations for diseases of the gall bladder.

It is further shown that the outcome of an inflammatory process in the gall bladder is unpredictable. Therefore delay in operating may lead to serious complications which greatly increase the difficulty of operation and the attendant mortality.

It is shown that the younger the patient when subjected to operation, the better the chance of an uneventful recovery and good end result

On the basis of these findings it is recommended that disease of the biliary tract be treated surgically as soon as the diagnosis is made unless the general condition of the patient makes such treatment dangerous without pre operative therapy

If this policy is pursued, we believe that the mortality rate in surgery of acute cholecystitis will be diminished and, perhaps, the progress of certain systemic diseases, such as cardiovascular and hypertensive disease, may be retarded

BIBLIOGRAPHY

- 1 GRAHAM, H F The value of early operation for acute cholecystitis *Ann Surg* 1931 93 1152
- 2 HUFER G J Errors in diagnosis and treatment of the more common acute abdominal conditions *West Virginia M J*, 1930, 26 11
- 3 JUDD and PHILLIPS Acute cholecystic disease *Ann Surg*, 1933 98 771
- 4 MENTZER S H The acute gall bladder manifesting few signs or symptoms *Surg Gynec & Obst* 1932 55 799
- 5 MILLER R H Acute cholecystitis *Ann Surg* 1930, 9 644
- 6 SMITH M K Treatment of acute cholecystitis *Ann Surg* 1933 98 766
- 7 STONE and OWINGS The acute gall bladder as a surgical emergency *Ann Surg*, 1933 98 760
- 8 WALTON A J A Text Book of the Surgical Dyspepsias New York Longmans & Greene 1923
- 9 ZINNEGER M Treatment of acute cholecystitis *Ann Surg* 1931 96 406

THE COLD PRESSOR TEST IN PREGNANCY

LEON C. CHESLEY, Ph.D. and ELIZABETH R. CHESLEY, A.B. Jersey City, New Jersey

VASOMOTOR instability, as shown by labile blood pressure is widely recognized as a characteristic of early primary hypertension. Emotional stimuli in the hypertensive or even prehypertensive subject often elicit marked rises in blood pressure. Several tests have been devised in which an effort has been made to standardize the stimulus. Hines and Brown have proposed the cold pressor test which measures the response of the blood pressure to the immersion of one hand in ice water. They state that prehypertensive patients give exaggerated blood pressure rises in the test thus enabling the clinician to predict their eventual hypertension.

Many writers believe that the toxemias of pregnancy exclusive of true nephritis are related to primary hypertension. Corwin and Herrick incline to the view that the subacute hypertensive toxemia of pregnancy is the response of the woman with latent or declared cardiovascular disease to the strain of pregnancy. If the cold pressor test enables one to pick out the patients with latent or potential cardiovascular disease as Hines and Brown believe then perhaps it would also enable one to detect patients likely to develop toxemia of pregnancy. This would be of great importance for the study of toxemia and might even be of some benefit to the patient.

Randall Murray and Mussey seem to have been the first to publish studies of the cold test in pregnancy. From their preliminary results it seemed that normal reactions to the test might preclude future toxemia, though a few of their toxemia patients gave normal responses in early pregnancy and later gave hyper reactions.

Reid and Teel, in their series of 159 observations antepartum and postpartum in 34 normal patients and repeated tests in 22 patients before and during toxemia, could find no con-

stancy in the results of the test. Not only were the responses of the same patient markedly variable from time to time but the test seemed to have no predictive value for either toxemia or primary hypertension. The test did not differentiate between primary and secondary hypertension. They cite the work of Pickering and Kassin who studied the cold test in a series of non pregnant patients and failed to confirm Hines and Brown in their conclusion that an exaggerated response to the test is indicative of potential latent, or frank primary hypertension.

Dieckmann, Michel, and Woodruff concluded that an abnormal response to the cold test indicated a good probability that the patient might 'develop a toxemia in which the hypertension is the predominant finding'.

Briggs and Oertling did cold tests on 33 pregnant patients. In patients having no family history of hypertension only 2 hyper reactors were found. Only 2 patients in this whole group showed any toxemia and these who were diagnosed as chronic glomerulonephritis were not the hyper reactors. In 44 patients having one hypertensive parent there were 13 hyper reactors. In this group 3 toxemias occurred all in hyper reactors. In 10 patients both parents were hypertensive. All gave hyper reactions to the cold test and 9 developed toxemia. The results of these various writers are summarized in Table I.

MATERIAL AND METHODS

In the present study all clinic patients were taken who reported in their third or early fourth month of pregnancy. A cold test was done at this time and repeated at the end of the eighth or early in the ninth month and again 6 weeks or more postpartum. When the two antepartum tests showed wide divergence as frequently happened, a third test was done at the patient's next clinic visit. In all 539 patients were given the test. Of these 22 did not deliver in the Margaret Hague

TABLE I—SUMMARY OF PUBLISHED DATA COMPARED WITH PRESENT STUDY OF COLD TEST IN PREGNANCY

Author	Cases		Number of tests	Blood pressure rise in millimeters mercury systolic or systolic/ diastolic			Toxemia		Minutes of ice water stimulation
	Number	Per cent of all		Upper normal response	Mean response	Range of responses	Number	Per cent incidence	
Normal reaction to cold test									
Randall Murray and Mussey	79	79.0	?	20	65/78	?	0	0	1
Reid and Teel	35*	89.7	137	20	16.4/10.4	up to 62	5	14.3	2
Dieckmann Michel and Woodruff	63	40.3	?	20	18.6	?	2 (7)	3.2 (11.3)†	2
Briggs and Oertling	208	80.3	?	?	?	?	2	0.9	?
Present series									
Systolic	454	82.4	896	24	12.8	0-22	47	10.3	1
Diastolic	416	83.0	840	24	15.0	0-21	47	11.0	1
Hyper reaction to cold test									
Randall Murray and Mussey	21	21.0	?	20	38.7/11.7	?	7	33.3	1
Reid and Teel	4	10.3	10+	20	20+	?	0	0	2
Dieckmann Michel and Woodruff	90	59.2	?	20	30+	?	13 (23)	16.7 (31.0)†	2
Briggs and Oertling	25	10.7	?	?	?	?	12	48.0	?
Present series									
Systolic	63	11.6	133	24	13	0-64	9	14.3	1
Diastolic	87	17.0	279	24	18	0-52	0	10.3	1

*3 patients had one cold test response of more than 20 millimeters mercury. 3 gave one response of more than 30 millimeters mercury including patients having transient abnormal vascular renal signs.
†Diagnosed as chronic glomerulonephritis.

Maternity Hospital. Therefore this study is based upon 517 deliveries. Two or more antepartum tests were done in 473 of these patients.

The patients were laid out flat on comfortable tables or cots, and after 20 minutes the blood pressure was checked repeatedly until it had apparently come to a basal level. Basal blood pressures were carefully obtained in all cases. The temperature of the ice water was almost always checked at 2 to 4 degrees C, and in every case the patient's hand was in actual contact with ice cubes. The hand was completely immersed well up to and over the wrist. Blood pressure readings were always made at 30 and 60 seconds, and every minute thereafter until the basal level had been attained. The hand was immersed for 1 minute, blood pressures were taken on the opposite arm. The diastolic pressure was taken at the point where the pulse sound

abruptly changed tone and became muffled. All tests were done by one of us (E. R. C.).

RESULTS AND DISCUSSION

Reid and Teel seem to be the only investigators to have studied the reproducibility of the cold test response in pregnancy. Their results indicate that the response is so extremely variable as to make the test of questionable value at best. We have, therefore, compared the 2 (sometimes 3 or 4) antepartum tests in each patient, and also have compared all tests both antepartum and postpartum. The results may be summarized as in Table II.

Thus between the 2 most divergent tests, when usually only 3 tests were done, differences as high as 48 millimeters of mercury in the systolic, and 52 millimeters in the diastolic pressure rises were found. The average discrepancy was 8.2/10.3, with a standard deviation

TABLE II—BLOOD PRESSURE RISE IN MILLIMETERS MERCURY—SYSTOLIC AND DIASTOLIC

	Number of cases	Mean*	Median	Mode	Standard deviation	Range
Difference in the most divergent antepartum tests	423	38/70	40/68		49/34	0-26.3
Difference in the 2 most divergent full term tests	452	33/59.5	35/59.0	37/75	38/75	0-43.2

* Mean difference of 38/70 mm. and 33/59.5 mm. are average differences between the most divergent test in antepartum and full term tests. The difference in the 2 most divergent full term tests was 33 millimeters mercury in the systolic pressure and 59.5 millimeters mercury in the diastolic pressure.

TABLE III—BIOMETRIC ANALYSIS OF RESPONSES IN FREQUENCY TO THE COLD PRESSOR TEST

Class	Number of cases	Blood pressure rise in millimeters mercury (systolic/diastolic)					Range
		Mean	Median	Mode	Standard deviation		
All patients	539	15.3/15.0	14.2/12.7	12.3/12.7	8.6/8.0		0/0-7/2
Family history	Negative	10	14.6/7.2	13.8/12.1	11.5/12.7	7.5/8.1	2/0-3/7.2
	Positive	14	15.7/15.3	14.6/12.3	11.0/13.0	9/9.1	1/0-4/15.0
Age	< 15	133	14.4/12.6	13/12.7	11.3/12.3	5.6/9.6	1/0-5/16.0
	16-30	303	15.3/12.7	14.0/12.1	11.6/12.6	9.1/8.1	1/0-4/15.0
Gestational	31-45	63	16.0/12	14.8/15.4	5/15.0	9/8	0/0-6/15
	I	23	5/12.8	4.6/7.7	11.4/12.8	7.3/8.1	0/0-6/11
	II	118	6.0/9.1	14.0/12.8	14.7/13.0	8.0/9.1	1/0-9/13
	III	63	13.6/16.8	2.0/12.4	11/13	7.4/7.4	0-5/14
	IV	3	3/6	1/5.2	11.0/14.1	7/9.0	1/0-1/15.0
	V	11	14.7/14.7	12.0/14.2		9/7.4	5/0-16/15.0
Weight	VI+	9	5/15.6	3.0/13.8		12/8.8	1/0-4/15
	< 140	14	15.7/7.6	14.0/13.3	10.0/13.4	7.6/7.7	1/0-5/15.0
	150-160	308	15.3/5	13/7.3	14.7/13.0	8.7/8.4	1/0-6/15
Weight/height	170+	89	11.3/11.0	12/13.3	11.2	11/10.0	1/0-16/11
	< 175	4	1.6/12.0	11.3/11.3	12.0	8/13	1/0-21/15
	76-85	353	1.7/13.1	14.3/12.6	11.3/13.8	8.4/8.6	1/0-13/11
Blood pressure	85+	8	1.8/5	23.8/23.7	1/5	7.4/7.0	1/0-1/14.1
	< 175	457	14.0/7.5	14.0/12.4	13/7.7	8.4/7.0	1/4-9/15.0
	175-185/85	78	17/13.3	7/13.1	14/10.7	11.0/8.0	0/0-13/15
Weight gain	185+	4	7/2.6			7/9	1/0-1/16
	18-28	111	15.1/7	13.6/7	12.3/12.7	7.5/7.0	1/0-14
	29-33	1	14.0/7.0	14/7.5	13.5/12.4	6.5/7.7	1/0-5/14
Patients who did not deliver	34	15.3/12.8	13/12.1	11.3/7.7	8/8.6		1/0-7/11
	50	15.7/16.0	13.8/7.5	5/6.7	13.3		1/0-6/15

* Mean blood pressure 155/80 mm. in the antepartum and 145/75 mm. in the postpartum. The difference in the 2 most divergent full term tests was 33 millimeters mercury in the systolic pressure and 59.5 millimeters mercury in the diastolic pressure.

amounting to 80 per cent of the mean. Among the antepartum tests the variability is somewhat less, but as Reid and Teel concluded in 'A Study of the 'Cold Test' in Normal and in Toxic Pregnancy' that it is still too great for the test to have much reliability.

An analysis has been made of the relation, if any, between the average response to the cold test and family history of cardiovascular renal disease and diabetes. The family history in many cases must be unreliable but if the patient definitely stated or denied that a

parent or grandparent had had a disease in this realm the history was taken as positive or negative. The analysis shown in Table III indicated that there is no significant difference between the 2 groups in the average range of responses. The response to the test, in pregnancy, does not seem to bear any relation to family history of cardiovascular disease. This, again, is in agreement with Reid and Tecl. It does not substantiate Briggs and Oerting.

The data in Table III are calculated from all tests, antepartum and postpartum except for the group of patients compared for the later development of toxemia. Since the postpartum test would not have any relevance for the prediction of toxemia, the data for this comparison represent antepartum tests only.

The response to the cold test in pregnancy is independent of age and gravidity, two factors which go hand in hand. According to Fishberg hypertension is more common in overweight, and particularly in squat subjects. It is interesting to see from Table III that in our series the response to the cold test is not influenced either by the weight or by the weight height index. The data are too few to decide the question as to the effect of the basal blood pressure upon the response. In the cases presented there is no significant difference between the groups. The patients have been divided into 3 groups based upon the weight gain in pregnancy, because excessive gain is often a harbinger of toxemia. The response to the cold test is the same in patients who gained more than 26 pounds as it is in any other group.

In our experience the cold pressor test has had no predictive value for the toxemias of pregnancy. As the literature and our cases indicate, the incidence of toxemia is essentially the same in both normal and hyperreacting groups. The analysis in Table III shows no difference in the pretoxemia and the "prenormal" patients. We have taken a rise in blood pressure of 24 millimeters of mercury as the upper normal limit, but whatever normal we might select the conclusion would remain the same. In Figure 1 are shown the frequency distributions of the responses in normal and in pretoxemic patients. In the

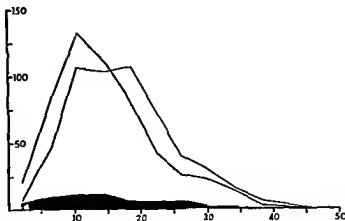


Fig 1 The frequency distribution of average antepartum responses to the cold pressor test in pregnancy. The peaked curve represents the distribution of systolic rises in blood pressure in response to the cold test. The platykurtic curve describes the distribution of diastolic responses. Both are for patients who did not develop toxemia of pregnancy. The shaded area shows the distribution of responses in patients who did develop late toxemia. Three normal and one pretoxemic patients having blood pressure rises of more than 50/50 millimeters mercury systolic/diastolic are not shown because of the discontinuous distribution of responses. Ordinates represent number of cases; abscissae the average antepartum response to the cold pressor test in millimeters mercury.

normal patients the range of response is wider than in the pretoxemic subjects. The distributions are roughly similar, although there were only 56 patients who subsequently developed toxemia.

Randall, Murray, and Mussey found that 13 per cent of their patients had decreases rather than increases in blood pressure when given the cold test. We have only very rarely seen such a reaction and it has never been found upon repetition of the test.

Since our results with the cold test are not in accord with some of the published claims for the test, it might be worthwhile to emphasize that we did the test in the proper and approved manner as indicated in the description of methods given here.

In the first 93 patients of our series, the cold test seemed to promise well, 12 patients gave hyper reactions and of these 5 developed toxemia. However, in the next 153 patients all toxemias developed in normal reactors and no toxemia appeared in patients giving hyperreactions. If these 2 groups had been taken as 2 series, comparable in length to some of the published series, diametrically opposite conclusions could have been drawn.

SUMMARY AND CONCLUSIONS

The published literature on the cold pressor test in pregnancy is summarized and tabulated. There is a close similarity in the reported incidences of hyper reaction to the cold test excepting 1 paper in which the incidence is 5 times that of the other publications. The predictive value for toxemia of pregnancy is unsettled. The series studied have been small. Reproducibility of the response to the test has not been considered in most cases.

In the present investigation cold tests have been done in the third or early fourth month again in the eighth or early ninth month and again 6 weeks or more postpartum in 517 women delivering in the Margaret Hague Maternity Hospital. This group is about equal in number to the total of the other 4 series reported.

The response to the cold test is inconstant. While many patients do give reproducible rises in blood pressure others have given highly variable responses at different times.

The response to the cold test in our series is independent of family history of cardiovascular renal disease and diabetes. It is also independent of age, gravidity, weight, weight-beight index, weight gain in pregnancy, and perhaps also the basal blood pressure.

The incidence of toxemia is essentially the same in both normal and hyper reacting groups. The frequency distribution of responses is essentially the same in both pre-toxic and "prenormal" groups.

We are especially grateful to Dr. S. A. Cosgrove for his sustained interest and efforts which made the work possible and for his criticisms of the manuscript. We are indebted to many of the nursing staff of the Margaret Hague Maternity Hospital for their co-operation.

BIBLIOGRAPHY

1. BRIGGS J. F. and OERTING H. The prognostic value of the cold test in pregnancy. *Minnesota Med* 1937 20 382.
2. CORWIN J. and HERATSK W. W. Relation of hypertensive toxemia of pregnancy to chronic cardiovascular disease. *J. Am. M. Ass.* 1927 88 457.
3. DIECKMANN W. J. MICHEL H. L. and WOODAUFF P. W. The cold pressor test in pregnancy. *Am. J. Obst. & Gynec.* 1938 36 408.
4. FRIEDBERG A. M. Hypertension and Nephritis. 3d ed. p. 512. Philadelphia: Lea & Febiger 1934.
5. HINES E. A. and BROWN G. E. A standard test for measuring the variability of blood pressure: its significance as an index of the prehypertensive state. *Ann. Int. Med.* 1935 7 99.
6. PICKERING G. W. and KESSIN M. Effects of adrenalin and of cold on blood pressure in human hypertension. *Clin. Sc.* 1936 2 201.
7. RANDALL L. M. MURRAY G. E. and MESSEY R. D. The cold test in pregnancy. A preliminary report of its use in prenatal care. *Am. J. Obst. & Gynec.* 1935 29 362.
8. REID D. E. and TEEL H. M. A study of the cold test in normal and in toxemic pregnancy. *Am. J. Obst. & Gynec.* 1938 35 305.

THE USE OF SILK IN THYROID SURGERY

J E DUNPHY, M D, and THOMAS W BOTSFORD, M D,
Boston, Massachusetts

A PRINCIPAL cause of wound complications in modern thyroid surgery is the use of catgut instead of fine silk. Halsted wrote, "when operating on two goiters the same day, employ catgut for the platysma suture in the one case and very fine silk in the other. There is not only greater local reaction in the cases sewed with catgut but in them the wounds will occasionally open at one or more points to discharge clear or cloudy fluid." More recently, the superiority of silk to catgut in thyroid surgery has been shown by Whipple, Meleney, and McGraw. Despite these studies, there is still a prevalent feeling that these wounds almost of necessity develop hematomas, that the use of a drain is necessary, and that infection is sufficiently frequent to contra-indicate the employment of a non-absorbable suture. The present study was undertaken to obtain evidence of the advantages of silk in thyroid surgery.

The material upon which this paper is based consists of 614 thyroidectomies. Silk was employed in 263 and catgut in 341 of these cases. Ten cases in which both types of suture material were used have been excluded. The wound complications have been divided into two groups, suppurative and non-suppurative. By non-suppurative complication is meant hematomas which require evacuation, palpable fluctuation or extensive induration requiring the application of heat for resolution, or a persistent discharge of serum for more than 4 days after the removal of the drain. A wound is considered infected whenever the drainage has been described as "cloudy," "yellow," "purulent," "seropurulent," etc. In most of the cases bacteriological proof of infection was available in the form of smears or cultures or both.

When silk was employed 0.38 per cent of the wounds developed suppurative and 13

per cent developed non-suppurative complications. When catgut was employed, these figures were 3.2 per cent and 40 per cent respectively. In other words, the non-suppurative complications are three times, and the suppurative complications eight times as numerous when catgut is used instead of silk. When the cases are divided into two groups, toxic and non-toxic, depending upon the factor of hyperthyroidism, the superiority of the wound healing when silk is used is equally apparent (Table I).

The importance of the suture material as a factor in wound healing is further demonstrated in Figure 1, which shows the relationship between the annual incidence of wound complications and the use of silk in thyroidectomy. During the years 1913 to 1916 inclusive, when silk was liberally used for suture material, the incidence of complications is remarkably low.

With the introduction of catgut as the customary suture material in 1917, there is a sharp rise in the curve which persists with only slight variation until 1932. Since then there has been a steady increase in the use of silk and there is a correspondingly lower incidence of complications. That this striking reduction in the incidence of wound complications is attributable to the use of silk is shown by the fact that, during this same period, there is no such change in the percentage incidence of wound complications in the cases in which catgut was the suture material (Fig. 2). In fact, it is worthy of note that, in the last 20 years, there has been no decrease in the incidence of wound complication in cases in which catgut was used. The faulty healing of wounds which occurs in the presence of large amounts of catgut is due to the irritating action of halogens and metals which are released during its absorption. (4) Chromicized catgut is particularly deleterious in this respect.

From the Surgical Service of the Peter Bent Brigham Hospital

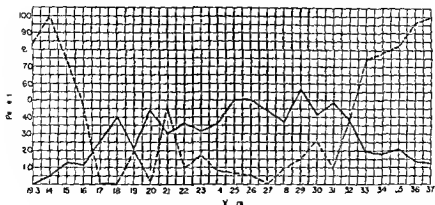


Fig. 1. Graph showing the relationship between the incidence of wound complications in thyroid surgery and the use of silk sutures in 604 thyroidectomies at Peter Bent Brigham Hospital: 263 sutured with silk, 341 with catgut. Percentage in which silk was used —percentage of total wound complications.

In order to determine the comparative importance of the suture in the healing of thyroidectomy wounds a study of the following factors was made: the age of the patient, the degree of hyperthyroidism, the type of anesthetic used, cachexia of the patient, the presence of diabetes mellitus, the use of drains and the technique of the operator. The incidence of wound complications was found to be higher in the older age groups and in the hyperthyroid cases. However, when the cases were divided into two groups according to the type of suture employed, it was found that the influence of these factors was very marked when catgut was used and negligible when silk was used. This has been interpreted as evidence that as Shambaugh has shown (7) the slower healing of the wound renders

complications more likely in the aged. The irritating effect of catgut increases this tendency, whereas silk has no such deleterious influence.

This is emphasized also in the hyperthyroid cases in which the technical difficulties encountered in the removal of friable vascular glands, especially bleeding, necessitate greater handling of tissues and the use of larger amounts of suture material. The use of silk in such cases minimizes wound complications. That hyperthyroidism is not *per se* a cause of wound complications is shown by the low incidence of complications which occurred when silk was used, even in cases of comparatively uncontrolled hyperthyroidism in the period before the use of iodine (Fig. 1). Moreover, the incidence of wound complications in the most severe cases of hyperthyroidism, namely, those in which a crisis occurred, was no higher than in the less toxic cases.

The influence of the anesthetic upon the subsequent morbidity was studied and a significant deleterious effect was noted only when the use of catgut was combined with a local infiltration anesthetic. When silk was used with local anesthesia, no such effect was produced. No correlation between the amount of weight which a patient had lost and the incidence of wound complications could be found in this series. No studies for vitamin C deficiency were made. There were 8 cases of diabetes mellitus, none of which developed wound complications. Controlled diabetes

TABLE 1.—EFFECT OF SUTURE MATERIAL UPON THE INCIDENCE OF WOUND COMPLICATION FOLLOWING THYROIDECTOMY FOR TOXIC AND NON TOXIC GOITER

Type of case	Suture material	Number of cases	Wound complications			
			Supportive		Anesthetic	
			No.	Per cent	No.	Per cent
Toxic	Silk	77	1	56	5	14.1
Toxic	Catgut	41	10	4	18	47.5
Non-toxic	Silk	85	0	0	7	6
Non-toxic	Catgut	90	0	0	3	3.3

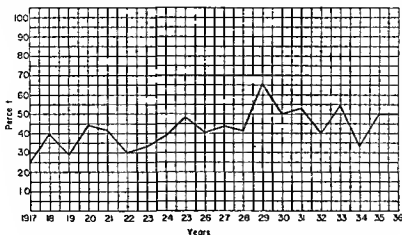


Fig 2 Graph showing the annual percentage of wound complications in cases in which catgut was used—341 cases. There has been no decrease in the percentage of complications in 20 years.

therefore, was not a factor in the production of wound complication in this series.

The role of drains in the production of infection is difficult to evaluate because the circumstances for which drainage is instituted are often responsible for the infection. The presence of hematomas in this connection is well known (13). However, it seems significant that in this series not a single thyroidectomy, either for toxic or non toxic goiter, in which fine silk was used and the wound was closed without drainage, was followed by infection. In this group there were 20 instances in which a hematoma formed in the wound but it did not require evacuation and infection did not supervene. When drainage was employed the incidence of infection was 1.4 per cent when

silk was used and 4.2 per cent when catgut was used. The percentage incidence of infection was, thus, three times as high in the drained as in the non drained cases (Table II).

It is frequently stated that if the same meticulous technique was employed with catgut as with silk the superiority of silk would be shown to be more apparent than real. Although a careful technique is essential, the present study indicates that comparable results are not obtained with catgut. A and B are two senior surgeons on the staff of the Peter Bent Brigham Hospital. Both surgeons are painstaking and meticulous operators. Surgeon A has nearly always employed fine silk in his cases and Surgeon B fine catgut. On occasions, however, each has departed from

TABLE II —EFFECT OF THE USE OF DRAINS ON THE INCIDENCE OF WOUND COMPLICATIONS IN THYROID SURGERY WHEN FINE SILK WAS USED AND NO DRAINAGE, NO SUPPURATIVE INFECTIONS OCCURRED

	No of operations	Wound complications			
		Suppurative		Non suppurative	
		No	Per cent	No	Per cent
Drained silk wounds	68	1	1.4	15	22.0
Undrained silk wounds	195	0	0	20	10.2
Drained catgut wounds	213	0	0	85	39.9
Undrained catgut wounds	228	2	1.56	53	23.2

TABLE III —COMPARATIVE INCIDENCE OF WOUND COMPLICATION, WHEN USING SILK AND CATGUT SUTURES, OBTAINED BY TWO METICULOUS OPERATORS, ONE ACCUSTOMED TO THE USE OF SILK BUT OCCASIONALLY USING CATGUT, AND VICE VERSA

Operator	Suture material	Wound complications per cent
A	Silk	8.9
	Catgut	33.0
B	Silk	0
	Catgut	36.9
Hospital staff	Silk	13.8
	Catgut	43.6

his own custom Table III shows the incidence of wound complications obtained by the two surgeons when using the different suture materials. Note that both surgeons have a low incidence of complications when silk is used and a high incidence when catgut is used. That the technique of these surgeons was unusually careful when using catgut is shown by the fact that the percentage of wound complications obtained by them is lower than that obtained by the remainder of the surgical staff (Table III).

Efficient methods of sterilization of instruments and dry goods, careful cleansing of the skin, exclusion of the skin from the operative field, adequate masking of the operating room personnel, gentle handling of tissue and meticulous hemostasis are fundamental principles without which satisfactory results with a fine silk technique cannot be obtained (1, 3, 6, 13). At the Peter Bent Brigham Hospital attention always has been directed to these details but occasionally inexplicable severe wound infections have been encountered. Recently a number of improvements in methods of sterilization have been inaugurated by Walter (10, 11, 12). It is hoped that these changes will reduce still further the incidence of wound complications.

Granting that the incidence of wound complications is appreciably lower when fine silk is used, an important question must be considered. What happens when silk is used and infection develops? In this regard the opinion of Halsted is of interest. 'If fine silk were used and the infection slight probably none of the buried threads would be extruded nor would healing be delayed demonstrably on account of their presence. When heavy silk has been used for any of the sutures and suppuration is considerable one or more or perhaps all of the threads would have to be removed. Even in such cases it is very unlikely that the ligatures and fine sutures would give trouble.' Recent studies (2, 7, 8, 9) have confirmed this statement. Although occasionally the presence of silk may delay healing, this is the exception rather than the rule. If a very fine grade of silk is used¹ if all sutures are cut close to the knot, if no con-

tinuous sutures are employed, and if strangulation and necrosis of tissue are avoided little or no trouble is encountered in the presence of infection. For ideal results when using silk, the size must be sufficiently small to permit complete encapsulation with mononuclear phagocytes if suppuration occurs. If a silk of small size is used persistent sinus tracts will not form for the foreign body will become completely encapsulated. After extensive infection fine silk may be extruded from the wound, but if it is of small size this will cause no discomfort to the patient and will not impair the solidity or final cosmetic appearance of the wound.

It is not intended that this study will encourage surgeons who have employed catgut for years to use silk in thyroidectomy. Such a change requires more than simply adopting a new suture material and it would not be practical for most surgeons to attempt it. Moreover, in no instance in this series was a wound complication responsible for a fatality.¹ However, there are certain practical advantages of the use of silk in thyroid surgery which merit consideration. Tenderness, swelling, and induration of the wound seldom develop. Consequently, the patients are more comfortable. The febrile period and the average hospital stay are about 3 days shorter with silk than with catgut. Nearly all of the patients are able to leave the hospital without a dressing on the wound and repeated dressings and proings of the wound after discharge are rarely necessary. The use of silk therefore shortens the period of morbidity and adds materially to the comfort of the patient.

SUMMARY

1. A study of the factors involved in the healing of over 600 thyroidectomy wounds reveals that when fine silk was used instead of catgut the incidence of non-suppurative wound complication was reduced from 40 per cent to less than 15 per cent and the incidence of suppurative complications from 32 per cent to 0.8 per cent.

Post op. 1 w. h. m. b. 215 s. at. cl. ded. w. d. mph. b. It. c. red. lightly 1.15 1.25 1.35 1.45 1.55 1.65 1.75 1.85 1.95 2.05 2.15 2.25 2.35 2.45 2.55 2.65 2.75 2.85 2.95 3.05 3.15 3.25 3.35 3.45 3.55 3.65 3.75 3.85 3.95 4.05 4.15 4.25 4.35 4.45 4.55 4.65 4.75 4.85 4.95 5.05 5.15 5.25 5.35 5.45 5.55 5.65 5.75 5.85 5.95 6.05 6.15 6.25 6.35 6.45 6.55 6.65 6.75 6.85 6.95 7.05 7.15 7.25 7.35 7.45 7.55 7.65 7.75 7.85 7.95 8.05 8.15 8.25 8.35 8.45 8.55 8.65 8.75 8.85 8.95 9.05 9.15 9.25 9.35 9.45 9.55 9.65 9.75 9.85 9.95 10.05 10.15 10.25 10.35 10.45 10.55 10.65 10.75 10.85 10.95 11.05 11.15 11.25 11.35 11.45 11.55 11.65 11.75 11.85 11.95 12.05 12.15 12.25 12.35 12.45 12.55 12.65 12.75 12.85 12.95 13.05 13.15 13.25 13.35 13.45 13.55 13.65 13.75 13.85 13.95 14.05 14.15 14.25 14.35 14.45 14.55 14.65 14.75 14.85 14.95 15.05 15.15 15.25 15.35 15.45 15.55 15.65 15.75 15.85 15.95 16.05 16.15 16.25 16.35 16.45 16.55 16.65 16.75 16.85 16.95 17.05 17.15 17.25 17.35 17.45 17.55 17.65 17.75 17.85 17.95 18.05 18.15 18.25 18.35 18.45 18.55 18.65 18.75 18.85 18.95 19.05 19.15 19.25 19.35 19.45 19.55 19.65 19.75 19.85 19.95 20.05 20.15 20.25 20.35 20.45 20.55 20.65 20.75 20.85 20.95 21.05 21.15 21.25 21.35 21.45 21.55 21.65 21.75 21.85 21.95 22.05 22.15 22.25 22.35 22.45 22.55 22.65 22.75 22.85 22.95 23.05 23.15 23.25 23.35 23.45 23.55 23.65 23.75 23.85 23.95 24.05 24.15 24.25 24.35 24.45 24.55 24.65 24.75 24.85 24.95 25.05 25.15 25.25 25.35 25.45 25.55 25.65 25.75 25.85 25.95 26.05 26.15 26.25 26.35 26.45 26.55 26.65 26.75 26.85 26.95 27.05 27.15 27.25 27.35 27.45 27.55 27.65 27.75 27.85 27.95 28.05 28.15 28.25 28.35 28.45 28.55 28.65 28.75 28.85 28.95 29.05 29.15 29.25 29.35 29.45 29.55 29.65 29.75 29.85 29.95 30.05 30.15 30.25 30.35 30.45 30.55 30.65 30.75 30.85 30.95 31.05 31.15 31.25 31.35 31.45 31.55 31.65 31.75 31.85 31.95 32.05 32.15 32.25 32.35 32.45 32.55 32.65 32.75 32.85 32.95 33.05 33.15 33.25 33.35 33.45 33.55 33.65 33.75 33.85 33.95 34.05 34.15 34.25 34.35 34.45 34.55 34.65 34.75 34.85 34.95 35.05 35.15 35.25 35.35 35.45 35.55 35.65 35.75 35.85 35.95 36.05 36.15 36.25 36.35 36.45 36.55 36.65 36.75 36.85 36.95 37.05 37.15 37.25 37.35 37.45 37.55 37.65 37.75 37.85 37.95 38.05 38.15 38.25 38.35 38.45 38.55 38.65 38.75 38.85 38.95 39.05 39.15 39.25 39.35 39.45 39.55 39.65 39.75 39.85 39.95 40.05 40.15 40.25 40.35 40.45 40.55 40.65 40.75 40.85 40.95 41.05 41.15 41.25 41.35 41.45 41.55 41.65 41.75 41.85 41.95 42.05 42.15 42.25 42.35 42.45 42.55 42.65 42.75 42.85 42.95 43.05 43.15 43.25 43.35 43.45 43.55 43.65 43.75 43.85 43.95 44.05 44.15 44.25 44.35 44.45 44.55 44.65 44.75 44.85 44.95 45.05 45.15 45.25 45.35 45.45 45.55 45.65 45.75 45.85 45.95 46.05 46.15 46.25 46.35 46.45 46.55 46.65 46.75 46.85 46.95 47.05 47.15 47.25 47.35 47.45 47.55 47.65 47.75 47.85 47.95 48.05 48.15 48.25 48.35 48.45 48.55 48.65 48.75 48.85 48.95 49.05 49.15 49.25 49.35 49.45 49.55 49.65 49.75 49.85 49.95 50.05 50.15 50.25 50.35 50.45 50.55 50.65 50.75 50.85 50.95 51.05 51.15 51.25 51.35 51.45 51.55 51.65 51.75 51.85 51.95 52.05 52.15 52.25 52.35 52.45 52.55 52.65 52.75 52.85 52.95 53.05 53.15 53.25 53.35 53.45 53.55 53.65 53.75 53.85 53.95 54.05 54.15 54.25 54.35 54.45 54.55 54.65 54.75 54.85 54.95 55.05 55.15 55.25 55.35 55.45 55.55 55.65 55.75 55.85 55.95 56.05 56.15 56.25 56.35 56.45 56.55 56.65 56.75 56.85 56.95 57.05 57.15 57.25 57.35 57.45 57.55 57.65 57.75 57.85 57.95 58.05 58.15 58.25 58.35 58.45 58.55 58.65 58.75 58.85 58.95 59.05 59.15 59.25 59.35 59.45 59.55 59.65 59.75 59.85 59.95 60.05 60.15 60.25 60.35 60.45 60.55 60.65 60.75 60.85 60.95 61.05 61.15 61.25 61.35 61.45 61.55 61.65 61.75 61.85 61.95 62.05 62.15 62.25 62.35 62.45 62.55 62.65 62.75 62.85 62.95 63.05 63.15 63.25 63.35 63.45 63.55 63.65 63.75 63.85 63.95 64.05 64.15 64.25 64.35 64.45 64.55 64.65 64.75 64.85 64.95 65.05 65.15 65.25 65.35 65.45 65.55 65.65 65.75 65.85 65.95 66.05 66.15 66.25 66.35 66.45 66.55 66.65 66.75 66.85 66.95 67.05 67.15 67.25 67.35 67.45 67.55 67.65 67.75 67.85 67.95 68.05 68.15 68.25 68.35 68.45 68.55 68.65 68.75 68.85 68.95 69.05 69.15 69.25 69.35 69.45 69.55 69.65 69.75 69.85 69.95 70.05 70.15 70.25 70.35 70.45 70.55 70.65 70.75 70.85 70.95 71.05 71.15 71.25 71.35 71.45 71.55 71.65 71.75 71.85 71.95 72.05 72.15 72.25 72.35 72.45 72.55 72.65 72.75 72.85 72.95 73.05 73.15 73.25 73.35 73.45 73.55 73.65 73.75 73.85 73.95 74.05 74.15 74.25 74.35 74.45 74.55 74.65 74.75 74.85 74.95 75.05 75.15 75.25 75.35 75.45 75.55 75.65 75.75 75.85 75.95 76.05 76.15 76.25 76.35 76.45 76.55 76.65 76.75 76.85 76.95 77.05 77.15 77.25 77.35 77.45 77.55 77.65 77.75 77.85 77.95 78.05 78.15 78.25 78.35 78.45 78.55 78.65 78.75 78.85 78.95 79.05 79.15 79.25 79.35 79.45 79.55 79.65 79.75 79.85 79.95 80.05 80.15 80.25 80.35 80.45 80.55 80.65 80.75 80.85 80.95 81.05 81.15 81.25 81.35 81.45 81.55 81.65 81.75 81.85 81.95 82.05 82.15 82.25 82.35 82.45 82.55 82.65 82.75 82.85 82.95 83.05 83.15 83.25 83.35 83.45 83.55 83.65 83.75 83.85 83.95 84.05 84.15 84.25 84.35 84.45 84.55 84.65 84.75 84.85 84.95 85.05 85.15 85.25 85.35 85.45 85.55 85.65 85.75 85.85 85.95 86.05 86.15 86.25 86.35 86.45 86.55 86.65 86.75 86.85 86.95 87.05 87.15 87.25 87.35 87.45 87.55 87.65 87.75 87.85 87.95 88.05 88.15 88.25 88.35 88.45 88.55 88.65 88.75 88.85 88.95 89.05 89.15 89.25 89.35 89.45 89.55 89.65 89.75 89.85 89.95 90.05 90.15 90.25 90.35 90.45 90.55 90.65 90.75 90.85 90.95 91.05 91.15 91.25 91.35 91.45 91.55 91.65 91.75 91.85 91.95 92.05 92.15 92.25 92.35 92.45 92.55 92.65 92.75 92.85 92.95 93.05 93.15 93.25 93.35 93.45 93.55 93.65 93.75 93.85 93.95 94.05 94.15 94.25 94.35 94.45 94.55 94.65 94.75 94.85 94.95 95.05 95.15 95.25 95.35 95.45 95.55 95.65 95.75 95.85 95.95 96.05 96.15 96.25 96.35 96.45 96.55 96.65 96.75 96.85 96.95 97.05 97.15 97.25 97.35 97.45 97.55 97.65 97.75 97.85 97.95 98.05 98.15 98.25 98.35 98.45 98.55 98.65 98.75 98.85 98.95 99.05 99.15 99.25 99.35 99.45 99.55 99.65 99.75 99.85 99.95 100.05 100.15 100.25 100.35 100.45 100.55 100.65 100.75 100.85 100.95 101.05 101.15 101.25 101.35 101.45 101.55 101.65 101.75 101.85 101.95 102.05 102.15 102.25 102.35 102.45 102.55 102.65 102.75 102.85 102.95 103.05 103.15 103.25 103.35 103.45 103.55 103.65 103.75 103.85 103.95 104.05 104.15 104.25 104.35 104.45 104.55 104.65 104.75 104.85 104.95 105.05 105.15 105.25 105.35 105.45 105.55 105.65 105.75 105.85 105.95 106.05 106.15 106.25 106.35 106.45 106.55 106.65 106.75 106.85 106.95 107.05 107.15 107.25 107.35 107.45 107.55 107.65 107.75 107.85 107.95 108.05 108.15 108.25 108.35 108.45 108.55 108.65 108.75 108.85 108.95 109.05 109.15 109.25 109.35 109.45 109.55 109.65 109.75 109.85 109.95 110.05 110.15 110.25 110.35 110.45 110.55 110.65 110.75 110.85 110.95 111.05 111.15 111.25 111.35 111.45 111.55 111.65 111.75 111.85 111.95 112.05 112.15 112.25 112.35 112.45 112.55 112.65 112.75 112.85 112.95 113.05 113.15 113.25 113.35 113.45 113.55 113.65 113.75 113.85 113.95 114.05 114.15 114.25 114.35 114.45 114.55 114.65 114.75 114.85 114.95 115.05 115.15 115.25 115.35 115.45 115.55 115.65 115.75 115.85 115.95 116.05 116.15 116.25 116.35 116.45 116.55 116.65 116.75 116.85 116.95 117.05 117.15 117.25 117.35 117.45 117.55 117.65 117.75 117.85 117.95 118.05 118.15 118.25 118.35 118.45 118.55 118.65 118.75 118.85 118.95 119.05 119.15 119.25 119.35 119.45 119.55 119.65 119.75 119.85 119.95 120.05 120.15 120.25 120.35 120.45 120.55 120.65 120.75 120.85 120.95 121.05 121.15 121.25 121.35 121.45 121.55 121.65 121.75 121.85 121.95 122.05 122.15 122.25 122.35 122.45 122.55 122.65 122.75 122.85 122.95 123.05 123.15 123.25 123.35 123.45 123.55 123.65 123.75 123.85 123.95 124.05 124.15 124.25 124.35 124.45 124.55 124.65 124.75 124.85 124.95 125.05 125.15 125.25 125.35 125.45 125.55 125.65 125.75 125.85 125.95 126.05 126.15 126.25 126.35 126.45 126.55 126.65 126.75 126.85 126.95 127.05 127.15 127.25 127.35 127.45 127.55 127.65 127.75 127.85 127.95 128.05 128.15 128.25 128.35 128.45 128.55 128.65 128.75 128.85 128.95 129.05 129.15 129.25 129.35 129.45 129.55 129.65 129.75 129.85 129.95 130.05 130.15 130.25 130.35 130.45 130.55 130.65 130.75 130.85 130.95 131.05 131.15 131.25 131.35 131.45 131.55 131.65 131.75 131.85 131.95 132.05 132.15 132.25 132.35 132.45 132.55 132.65 132.75 132.85 132.95 133.05 133.15 133.25 133.35 133.45 133.55 133.65 133.75 133.85 133.95 134.05 134.15 134.25 134.35 134.45 134.55 134.65 134.75 134.85 134.95 135.05 135.15 135.25 135.35 135.45 135.55 135.65 135.75 135.85 135.95 136.05 136.15 136.25 136.35 136.45 136.55 136.65 136.75 136.85 136.95 137.05 137.15 137.25 137.35 137.45 137.55 137.65 137.75 137.85 137.95 138.05 138.15 138.25 138.35 138.45 138.55 138.65 138.75 138.85 138.95 139.05 139.15 139.25 139.35 139.45 139.55 139.65 139.75 139.85 139.95 140.05 140.15 140.25 140.35 140.45 140.55 140.65 140.75 140.85 140.95 141.05 141.15 141.25 141.35 141.45 141.55 141.65 141.75 141.85 141.95 142.05 142.15 142.25 142.35 142.45 142.55 142.65 142.75 142.85 142.95 143.05 143.15 143.25 143.35 143.45 143.55 143.65 143.75 143.85 143.95 144.05 144.15 144.25 144.35 144.45 144.55 144.65 144.75 144.85 144.95 145.05 145.15 145.25 145.35 145.45 145.55 145.65 145.75 145.85 145.95 146.05 146.15 146.25 146.35 146.45 146.55 146.65 146.75 146.85 146.95 147.05 147.15 147.25 147.35 147.45 147.55 147.65 147.75 147.85 147.95 148.05 148.15 148.25 148.35 148.45 148.55 148.65 148.75 148.85 148.95 149.05 149.15 149.25 149.35 149.45 149.55 149.65 149.75 149.85 149.95 150.05 150.15 150.25 150.35 150.45 150.55 150.65 150.75 150.85 150.95 151.05 151.15 151.25 151.35 151.45 151.55 151.65 151.75 151.85 151.95 152.05 152.15 152.25 152.35 152.45 152.55 152.65 152.75 152.85 152.95 153.05 153.15 153.25 153.35 153.45 153.55 153.65 153.75 153.85 153.95 154.05 154.15 154.25 154.35 154.45 154.55 154.65 154.75 154.85 154.95 155.05 155.15 155.25 155.35 155.45 155.55 155.65 155.75 155.85 155.95 156.05 156.15 156.25 156.35 156.45 156.55 156.65 156.75 156.85 156.95 157.05 157.15 157.25 157.35 157.45 157.55 157.65 157.75 157.85 157.95 158.05 158.15 158.25 158.35 158.45 158.55 158.65 158.75 158.85 158.95 159.05 159.15 159.25 159.35 159.45 159.55 159.65 159.75 159.85 159.95 160.05 160.15 160.25 160.35 160.45 160.55 160.65 160.75 160.85 160.95 161.05 161.15 161.25 161.35 161.45 161.55 161.65 161.75 161.85 161.95 162.05 162.15 162.25 162.35 162.45 162.55 162.65 162.75 162.85 162.95 163.05 163.15 163.25 163.35 163.45 163.55 163.65 163.75 163.85 163.95 164.05 164.15 164.25 164.35 164.45 164.55 164.65 164.75 164.85 164.95 165.05 165.15 165.25 165.35 165.45 165.55 165.65 165.75 165.85 165.95 166.05 166.15 166.25 166.35 166.45 166.55 166.65 166.75 166.85 166.95 167.05 167.15 167.25 167.35 167.45 167.55 167.65 167.75 167.85 167.95 168.05 168.15 168.25 168.35 168.45 168.55 168.65 168.75 168.85 168.95 169.05 169.15 169.25 169.35 169.45 169.55 169.65 169.75 169.85 169.95 170.05 170.15 170.25 170.35 170.45 170.55 170.65 170.75 170.85 170.95 171.05 171.15 171.25 171.35 171.45 171.55 171.65 171.75 171.85 171.95 172.05 172.15 172.25 172.35 172.45 172.55 172.65 172.75 172.85 172.95 173.05 173.15 173.25 173.35 173.45 173.55 173.65 173.75 173.85 173.95 174.05 174.15 174.25 174.35 174.45 174.55 174.65 174.75 174.85 174.95 175.05 175.15 175.25 175.35 175.45 175.55 175.65 175.75 17

2 Suppurative complications were more frequent in the cases in which drainage of the wound was employed. In this series there were no infections following thyroidectomy when fine silk was used and the wound closed primarily.

3 No other factor produced so favorable an influence on wound healing as the use of fine silk. Comparable results were not obtained with catgut even when a careful technique was followed.

4 The importance of a careful technique and proper methods of sterilization of instruments and dry goods is emphasized.

5 Postoperative discomfort is minimized and the period of morbidity shortened when silk is used.

BIBLIOGRAPHY

- 1 DAVIS J S Importance of adequate masking during operation *Ann Surg* 1934 100 1008-1015
- 2 DUNPHY, J E Operative treatment of pilonidal sinus with especial reference to type of suture material as factor in recurrence *Surgery* 1937 2 581-584
- 3 HALSTED, W S The employment of fine silk in preference to catgut and the advantages of transfixing tissues and vessels in controlling haemorrhage *Surgical Papers* vol 1 pp 29-46 The Johns Hopkins Press, 1924
- 4 KRAISSL C J Intrinsic factors altering absorption of catgut *Surg Gynec & Obst* 1936 63 561-569
- 5 MCGRAW A B Short interval stage operations for severe hyperthyroidism *Ann Surg* 1938 107 198-206
- 6 MILENEY F L Infection in clean operative wounds 9 year study *Surg Gynec & Obst* 1935 60 264-276
- 7 SHAMBAUGH P Postoperative wound complications clinical study with special reference to use of silk *Surg Gynec & Obst* 1937, 64 765-771
- 8 SHAMBAUGH P and DUNPHY, J E Postoperative wound infections and use of silk *Experimental study Surgery* 1937 1 379-383
- 9 THOMPSON MALCOLM Local treatment of wounds *Am J Surg* 1935 27 302-310
- 10 WALTER C Critique of steam sterilization *New England Hospital Association Report*
- 11 Idem Technique for the rapid and absolute sterilization of instruments *Surg Gynec & Obst* 1938 67 244-248
- 12 Idem The use of a mixture of coconut oil derivatives as a bactericide in the operating room *Surg, Gynec & Obst* 1938 67 683-688
- 13 WHIPPLE A O Use of silk in repair of clean wounds *Ann Surg* 1933 98 662-671

INTRASPINAL CAUSES OF LOW BACK AND SCIATIC PAIN

Results in Sixty Consecutive Low Lumbar Laminectomies

F KEITH BRADFORD M D, and R GLEN SPURLING M D F A C S
Louisville Kentucky

THE purpose of this report is to review the findings in a series of 60 consecutive cases in which a lumbar laminectomy was performed for the relief of low back and sciatic pain. The series therefore comprises a heterogeneous group pathologically but clinically a group not easily differentiated. We believe that in no other way than by a summarization of such a consecutive series of surgical cases can a proper perspective of this perplexing problem be obtained.

The symptomatology of the entire group was with minor variations the same. However based upon the gross and microscopic findings the patients logically fall into 4 groups: (1) herniated nucleus pulposus (35), (2) hypertrophy of the ligamentum flavum (13), (3) true neoplasms (3), and (4) negative surgical explorations (9). In attempting to analyze the data we shall discuss first the symptoms and signs common to the entire group and then attempt to correlate the symptomatology with a particular pathological lesion.

SYMPTOMS

There are certain symptoms especially important in examining the patient with low back and sciatic pain. Recurring episodes of similar pain are characteristic of the intraspinal lesions particularly of the herniated nucleus pulposus. Therefore, a history of a previous episode may be important in the differential diagnosis. Exaggeration of the pain by coughing and sneezing is of especial importance, even if present at one stage of the illness and absent at the time of examination. When the pain is thus intensified it may be most severe in the lower back or gluteal regions rather than in the peripheral

distribution of the sciatic nerve. Inquiry in regard to partial or complete impotence is of importance inasmuch as this symptom is frequent in lesions compressing the sacral roots.

In performing the neurological examination it is important to note whether the patient lists toward or away from the painful side. Spasticity of the lumbar muscles is common and usually accompanied by limitation of movement. This limitation is apt to be much greater in flexion than in lateral movement or extension of the spine. This finding varying in degree from slight limitation to almost complete immobility, was present in every patient of our series. Compression of the jugular veins in some instances increases the pain (Nassiger test) and when positive we consider the test to be pathognomonic of an intraspinal lesion. Every one of the lumbar and sacral dermatomes should be tested for changes of sensation to pin prick, cotton wool, heat, and cold. Sensory changes subjective or objective are most helpful in localization of these lesions. In addition to testing the power of the flexors and extensors of the hip and knee it is important to test minutely the motor power in the dorsiflexors, plantar flexors, evertors and invertors of the ankle and the extensors and flexors of the toes.

Lasegue's test is probably the most reliable one for demonstrating sciatic nerve irritation. It is performed by raising the thigh to right angles with the trunk with the knee flexed. Then the leg is extended on the thigh to the point, if any, at which pain begins along the course of the sciatic nerve. Without further moving the leg or thigh the foot is passively dorsiflexed to determine if this additional pull on the sciatic nerve exaggerates the pain. Lasegue emphasized the fact that many of his patients with severe 'sciatica' kept the foot of the affected side in plantar flexion and

could not press it flat to the floor without agonizing pain

The separate spinous processes of the lower lumbar vertebrae and the sacrum should be percussed and pressed firmly in a lateral direction to elicit tenderness. Although it occurs rarely, if manipulation of the spinous processes reproduces the patient's sciatic pain, it is considered of special significance.

In every case in which there is a localized area of pain along the course of the sciatic nerve or its branches careful local examination for regional pathology should be made. We have recently observed a patient with typical sciatic nerve irritation in whom a large streptococcal abscess was demonstrated deep in the gluteal region. Occasionally, neuromas, other tumors, or inflammatory masses in the course of the sciatic nerve are discovered, thus giving an extraspinal answer to the cause of "sciatica."

Pain was the disabling factor in 59 of the 60 patients. In 1 patient with hypertrophied ligamentum flavum there was no pain, but a trophic ulcer of the heel, incontinence of urine and feces, and saddle anesthesia were present. Although sciatic pain was not a symptom in all cases, there was a positive Lasègue's test in every patient operated upon. The degree of positiveness, however, was quite variable, the test being very marked in all cases in which sciatic pain was the most prominent symptom.

As would be expected, the Queckenstedt test was normal in all instances since the spinal puncture was made above the level of the suspected lesion.

ANALYSIS OF DATA

Herniated nucleus pulposus. Herniated nucleus pulposus was found in 35 patients. In 29 patients simple herniation through a small aperture in the annulus fibrosus was found, in 3, simple bilateral herniation, in 3, a disruption of the posterior part of the disk with both annulus fibrosus and nucleus pulposus protruding into the canal. Twenty-one herniations were at the level of the fourth lumbar disk, 13 at the lumbosacral disk, and 1 at the third lumbar disk. Twenty-five were males and 10 females. The ages ranged from 17 to

60 with an average age of 40 years. There was a definite traumatic history in 17 cases, questionable in 4, and negative in 14.

Sciatic pain was the first symptom in 16 patients, or 45 per cent, low back pain the first complaint in 18, or 52 per cent, and 1 patient noted the initial pain in the hip. At the time of examination, months, or years later, sciatic pain was the major complaint in 51 per cent of the patients and in 40 per cent the chief complaint was low back pain accompanied by sciatic pain. In the remainder the major pain was in the hip, groin, or sacral region in addition to the back.

The duration of symptoms in this group varied from a few weeks to 23 years with a tendency toward exacerbations and remissions. In 13 cases, or 40 per cent, there had been previous attacks of pain with occasional symptom-free periods. There was pain on coughing, straining, and sneezing in 27 cases, or 77 per cent. In 12 instances, or 35 per cent, the Naffziger test was positive.

Demonstrable hypesthesia or anesthesia in one or more of the lumbar or sacral dermatomes occurred in all except 8 patients, or in 77 per cent. In 1 patient there was only perianal hypesthesia. The hypesthesia or anesthesia involved the lateral aspect of the calf, particularly just above the ankle, in 23 patients, or 65 per cent. In other instances, the great toe or the lateral 3 toes were also involved. In 21 cases, or 60 per cent, the hypesthetic or anesthetic areas were limited to the lateral aspect of the leg and the foot.

Because of the severe pain in many cases it was difficult to evaluate the degree of motor deficit. When it appeared that weakness was purely secondary to the pain caused by muscular contraction, it was ignored. However, in 5 patients there was demonstrable weakness of the anterior tibial muscle on the affected side and in 3 instances it was severe enough to produce foot drop. Muscular fibrillations were noted in but 1 patient of this group.

In 15 of the 35 patients the ankle jerk was diminished or lost on the affected side, or in 43 per cent. Ten of these 15 patients had lesions at the lumbosacral joint and in the 5 others the lesion was at the fourth lumbar

interspace This finding indicates a considerably greater incidence of diminished ankle jerk with herniated nucleus pulposus at the lumbosacral disk than at the fourth lumbar disk since 10 of the 13 cases involving the lumbosacral disk and only 5 of the 21 cases involving the fourth lumbar disk had diminution of the ankle jerk.

The knee jerk was diminished in 3 patients 2 in which the herniation was at the fourth lumbar disk and 1 at the lumbosacral disk.

The total protein was determined in 16 patients. It was below 40 milligrams per cent in 4 instances and varied between 50 and 141 milligrams per cent in the remaining patients. In no patient was there an increase of cells in the spinal fluid.

Hypertrophy of the ligamentum flavum Hypertrophy of the ligamentum flavum between the fourth and fifth lumbar lamina or the fifth lumbar and sacral laminae was found in 13 patients. Cases were reported as hypertrophy of the ligamentum flavum only when the histological examination coincided with the surgical opinion. One case of herniated nucleus pulposus was accompanied by a frank hypertrophy of the ligamentum flavum and the 2 lipidol defects were shown clearly before operation. Other cases of herniated nucleus pulposus were associated with varying degrees of hypertrophy of the ligamentum flavum. Nine of the 13 cases of hypertrophied ligamentum flavum occurred in the first 30 cases of the series. This may have been partly coincidence however, as was the occurrence of all 13 neoplasms in this same group. Ten patients were males and 3 females. Ages ranged from 16 to 57 years with an average age of 39 years. There was a history of definite trauma in 4 cases questionable trauma in 2 and no trauma in 7.

The symptoms in 4 patients were initiated by sciatic pain in 3 by low back and sciatic pain, in 3 by backache alone and in 2 by pain in the posterior thigh. One patient had as his first complaint an ulcer on his heel. At the time of examination unilateral sciatic pain was the predominant symptom in 6 bilateral sciatic pain in 1. Back pain accompanied by sciatic pain was present in 1 patient. Pain was limited to the posterior thigh in 1 pa-

tient, the back, groin, and sciatic distribution in 1, the back alone in 1 and to the back and hip in 1 patient. Pain was present on coughing and sneezing in 10 patients, in 3 of which the Naffziger test was positive.

Slight difficulty with the urinary sphincter was noted in 3 patients, with incontinence of urine in 1. Libido was lost in 2 patients and diminished in 1. This contrasts with the much larger series of herniated nucleus pulposus in which neither libido nor sphincters were affected. The explanation is probably that hypertrophied ligamentum flavum is more frequently bilateral.

There was numbness of the affected leg or foot in 6 patients of the buttocks in 1, and of both legs below the knees in 1. Of these only 6 showed hypesthesia or anesthesia 2 in the perianal region 2 in all the sacral segments of one side, and 2 in the anterolateral surface of the leg. Motor weakness was observed in the tibialis anterior in 1 patient and the extensor hallucis longus in 1. Two patients appeared to have some weakness of the leg muscles but it was difficult to estimate because of the pain factor. The ankle jerk on the affected side was diminished in 3 patients lost in 2, and the knee jerk was diminished in 2. Both ankle jerks were absent in 1 instance. The total protein was estimated in 11 cases in which it varied between 50 and 148 milligrams per cent.

Neoplasms The 3 neoplasms found in this series consisted of a dermoid tumor in a man 59 years of age, a neurofibroma in a woman 55, and an epidermoid tumor in a boy 13. Pain in the back and sciatic distribution was the dominant symptom in each instance. The pain became progressively more severe and there was no history of remission. Pain was intensified by coughing and sneezing in 2 of the patients 1 of whom had a positive Naffziger test. Perianal numbness and hypesthesia were present in 2 with no sensory disturbance in the third. There was no motor weakness demonstrated in any of these patients. The regional tendon reflexes were normal in 2 patients but in the third both ankle jerks were lost. Total protein was 140 milligrams per cent in the case of neurofibroma and normal in the 2 other patients.

Negative explorations It is in this group that we consider a likelihood of having missed a herniated nucleus. The fact that most of this group were satisfactory surgical results does not invalidate this assumption because it seems quite possible that a simple spinal decompression, particularly if the posterior rim of the intervertebral foramen is removed, may afford relief of pressure upon a root from a small herniated nucleus.

In the negative group 5 of the 9 explorations were upon females. The ages ranged between 23 and 52 years with an average age of 38 years. There was questionable trauma in but 1 of the 9 patients. Pain occurred first in the back in 7 patients, in the sciatic distribution in 1, and in the perianal region in another. At the time of examination the pain was present in the back and hip in 4 patients, in the sciatic distribution in 2, in the back and sciatic distribution in 1, in the back, groin, and knee in 1, and in the back alone in 1 patient. Pain was exaggerated by coughing and sneezing in 7 of the 9 patients, but in only 2 was the Naffziger test positive. Localized numbness was referred to the calf and foot in 2 patients, to the lower extremity as a whole in 1, and to the perianal region in 1. Hypesthesia was found in all the sacral segments of 4 patients, in the perianal region of 1, and in the lateral aspect of the right leg and foot in 1. There was no motor weakness observed in any of these patients. The ankle jerk was diminished on the affected side in 2 patients and lost in 1. The knee jerk was decreased and both ankle jerks absent in 1 patient. The total protein of 4 patients was estimated, 1 being normal and the 3 others being 45, 50, and 75 milligrams per cent, respectively.

SUMMARY OF DATA

Disability was more apparent in the cases of herniated nucleus pulposus and hypertrophied ligamentum flavum than in the negative group. Pain throughout the distribution of the sciatic nerve, although at times secondary in severity to back pain, was present in 88 per cent of the patients with herniated nucleus pulposus and hypertrophied ligamentum flavum while it was present in

only 33 per cent of the negative explorations. It can, therefore, be said that in the great majority of instances low back pain indicates an intraspinal lesion only when accompanied by sciatic pain.

One useful differential sign becomes apparent from the statistical summary herein. In 60 per cent of the cases of herniated nucleus pulposus there was hypesthesia or anesthesia limited to the lateral aspect of the leg or foot or both. In contrast, the cases of hypertrophied ligamentum flavum and the negative group showed areas of hypesthesia elsewhere, but in only 15 per cent and 11 per cent, respectively, was hypesthesia limited to these areas. Localized hypesthesia or anesthesia in the lateral aspect of the leg or foot could not be expected in a larger percentage of cases of herniated nucleus pulposus since involvement of one root alone can not cause hypesthesia. However, well localized paresthesias occurred in many of the patients with single root involvement and are of real diagnostic importance.

In a small percentage of the patients with hypertrophied ligamentum flavum the probable lesion could have been predicted by the widespread signs of sacral root compression.

LIPIODOL INVESTIGATION

There can be no justification for lipiodol study of the subarachnoid space unless the patient has been subjected to a complete, careful, general examination and neurological study. Such a study would naturally include plain roentgenograms of the spine and pelvis. If the neurological examination strongly indicates the presence of an intraspinal lesion and if reasonable conservative methods have failed to bring relief of symptoms then, and only then, should lipiodol injection be resorted to.

Plain films of the spine were not available in some of our cases, therefore, a statistical review of these data is impossible. We may state, however, that narrowing of the intervertebral joint spaces has been present in a number of our patients with herniated nucleus pulposus but has by no means been a constant finding. Also, several patients have shown arthritis limited to the site of a herniated nucleus pulposus.



Fig 1

Fig 1 Left side defect quite typical of herniated nucleus pulposus are shown. The left sided defect is located at the fourth lumbar interspace that of the right at the fifth.

Fig 2 Representation of the relation of the thecal sac and lower lumbar and sacral nerves to the pedicles and intervertebral disks of the lower spine. The area usually filled with lipiodol is black and the axillary pouches are marked with A. (After Hampton and Robinson)

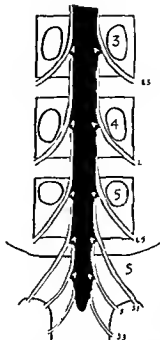


Fig 2



Fig 3

Fig 3 This roentgenogram was taken with the patient in the prone position on a tilting fluoroscopic table. The lipiodol is not in the terminal sac as it would appear but has been balanced opposite the lumbosacral disk. There is slight deviation of the column to the right in its lower portion but far more remarkable is the absence of the axillary pouch of the fifth lumbar nerve on the left side. In this case herniated nucleus pulposus from the lumbosacral disk had occurred far laterally.

We have on the other hand observed a few patients with grossly narrowed joint spaces in whom complete examination including the use of lipiodol was negative for intra spinal pathology.

When the decision to use lipiodol has been reached it is injected at the time of the first lumbar puncture after having made manometric readings and after having withdrawn a small amount of the fluid for cell count and total protein estimations. This is usually performed the day before the patient is to be fluoroscoped, because by so doing we have found the column to be smooth and show less tendency to spread into droplets than if the injection had been made just prior to the roentgenographic examination.

Two cubic centimeters of lipiodol which is preserved in glass ampules we believe quite sufficient for demonstration of any filling de-

fects in the lower lumbar canal (Fig 1). There are several theoretical considerations indicating that this amount of opaque oil is adequate. With the patient in a prone position the anterior wall of the spinal canal forms a trough for the passage upward and downward of the opaque material. Since the lumbar and sacral nerves leave the subarachnoid space well anteriorly even this small amount of lipiodol fills the axillary pouches. Fortunately the lesions involving either the ligamentum flavum or nucleus pulposus are prone to occur in the region of the third fourth and fifth lumbar interspaces. In this area the concavity of the canal with the patient prone is sufficient to keep the 2 cubic centimeters of lipiodol in a compact segment. By raising and lowering the fluoroscopic table this compact segment can be placed opposite any of the intervertebral disks at will.

It is true that with 2 cubic centimeters of lipiodol, bizarre distribution occurs as the head is lowered and the contrast medium passes opposite the upper 2 lumbar vertebrae into the thoracic region. In these areas the opaque material is no longer in a compact segment but is spread out to a length several times that which occurs in the lower lumbar canal. This spread is caused by the lipiodol resting first on a flat and then a convex surface rather than on the concave surface of the lower lumbar and sacral regions. For these same reasons a larger amount of lipiodol may form the same bizarre distribution.

We can conceive of but one condition in which larger amounts of lipiodol may be necessary for diagnosis, and that is the herniated nucleus pulposus which is displaced into the spinal canal only during weight bearing in the upright position. In such an instance, it would be an advantage to have sufficient lipiodol to fill the canal above the interspace in question so that roentgenograms could be taken with the patient standing.

On the other hand, larger amounts of lipiodol may obscure a small anterior defect unless it is observed just as the head of the advancing column reaches it. We have observed 1 patient in whom 2 cubic centimeters were sufficient to obscure a small defect when the column was compact and only when the column was thinned out by the changing positions were we able to visualize the lesion. In a number of doubtful cases we have injected an additional 2 cubic centimeters of lipiodol, making a total of 4 cubic centimeters. In no instance was it possible to demonstrate a defect more clearly than it had previously been demonstrated with the smaller amount.

Interpretation of the lipiodol examination may be very simple when the lesion is obvious and most difficult when the lesion is more obscure. Gross defects, of course, can easily be seen under the fluoroscope. However, the more deceptive defects can be demonstrated only with roentgenograms, preferably made as serial exposures. The clear cut unilateral filling defect opposite a disk indicates a herniated nucleus pulposus. The defect of hypertrophied ligamentum flavum is more apt to be bilateral and opposite the vertebral body.

In a few patients hypertrophied ligamentum flavum has caused narrowing of the terminal 3 to 5 centimeters of the sac rather than a typical "hour glass" contraction.

Complete blockage to the passage of lipiodol may occur with any 1 of the 3 lesions described, the blockage, of course, being entirely due to the size of the mass within the spinal canal.

The failure of 1 axillary pouch to fill with lipiodol may be the only positive evidence of an intraspinal lesion (Figs 2 and 3). Operation was performed in 7 instances because of an absent axillary pouch. In 3 patients a herniated nucleus pulposus was found but in 4 the exploration was negative. Three of the 4 negative explorations did not have characteristic histories and findings of an intraspinal lesion, but the 3 positives had perfectly classical symptoms and signs. Therefore, it is most important before interpreting such a minor lipiodol defect to have a clear cut clinical picture to corroborate it.

SURGICAL TECHNIQUE

The usual midline incision is made from the spinous process above to the second spinous process below the level of the suspected lesion. Identification of the exact level in the lower lumbar canal is often difficult and it is most helpful to include in the incision the spinous process of the first sacral vertebra. Hemilaminectomy is performed over the lipiodol defect provided that both the pain and the defect are unilateral. If a greatly thickened ligamentum flavum is discovered, the bony exposure is carried to the opposite side in order to remove it completely. Even with unilateral laminectomy it is not necessary to disturb the articular facets because by dissecting the ligamentum flavum beneath the lateral margin of the lamina sufficient exposure of the anterior neural canal for the removal of the lesion is easily accomplished.

When the lesion is exposed incision is made in the posterior longitudinal ligament just sufficiently large to remove the pulpy herniated material. In many instances, spontaneous extrusion of the material occurs. In others it is necessary to tease the mass out of

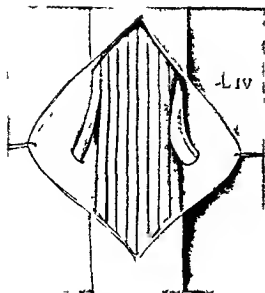


Fig 4 The fourth lumbar vertebra in the right is swollen and projects from its foramen in an abnormal manner. This may be the only evidence of root compression laterally in the intervertebral foramen.

the incision. After the herniated material has been removed the opening into the intervertebral disk can readily be entered with a pointed instrument. If the rent is a large one the pituitary rongeur is frequently introduced into the interior of the disk and the remainder of the nucleus pulposus removed as thoroughly as possible. In several instances we have found the herniated nuclear material to have dissected beneath the posterior longitudinal ligament upward or downward and when exposed at operation the mass was present not at the intervertebral disk but over the vertebral body.

We have found it possible in almost every instance to remove these lesions extradurally even when the dura has been opened to identify and localize the lesion. The danger of arachnoidal adhesions after the intradural manipulation is a real one and in 1 of our patients disabling symptoms have persisted because of them. Another important reason for not opening the dura is that should a wound infection occur the likelihood of meningitis is greatly reduced.

It is true that by not opening the dura examples of choked root (Fig 4) may not be observed but this is of no consequence if the

lesion has been identified. In some of the earlier cases a swollen root projecting at an angle quite different from that of the opposite side has led to the discovery of the lesion far lateralward. The mechanism of this root engorgement is probably the same as in choking of the optic disks, namely, compression of the veins accompanying the nerve.

It is necessary at times to expose the intervertebral foramen in order to remove a lateral herniation of the nucleus pulposus. These lateral herniations protruding into the intervertebral foramen are the most difficult to identify and as a consequence, are most likely to be overlooked by the operator. The presence of a choked root is a most reliable guide to this probable location.

In conclusion, we believe that the best results will occur when the bone removal has been minimal when the articular facets have not been disturbed and when the lesion has been removed extradurally.

ANESTHESIA AND POSTOPERATIVE TREATMENT

Forty six of the 60 patients were operated upon under procaine hydrochloride infiltration and block anesthesia. Pentobarbital sodium, 0.2 gram was given orally $1\frac{1}{2}$ hours before the operation was started. One hour before the operation 0.02 gram of dilaudid and 0.04 gram of hyoscine hydrobromide were given hypodermically. Frequently half the dose of dilaudid and hyoscine hydrobromide was repeated as the incision was made. This gave a satisfactory "twilight" state so that the patients remained quiet under local anesthesia. Frequently, it was necessary to infiltrate a single root in its dural sleeve during removal of the ligamentum flavum or the herniated nucleus pulposus from beside or beneath it. On several occasions a small amount of spinal procaine hydrochloride (0.025 to 0.050 gram) was placed intrathecally in order to avoid pain from extensive manipulation of the roots. When intrathecal administration is necessary the subarachnoid space is always blocked above with a cotton pledget to prevent upward diffusion of the procaine. Patients operated upon in this way stand the operation remarkably well. They

are able to take fluids after operation so that parenteral fluid administration has rarely been necessary. None of the patients have had a very unpleasant recollection of the operation.

Nine patients were operated upon and an average of 90 cubic centimeters of ether and 100 cubic centimeters of olive oil was used rectally. It was necessary to use the same local infiltration with 1 per cent procaine hydrochloride as was true with "twilight sleep." This was very satisfactory in all patients except 1 in whom unusual complications occurred which will be described later.

In 3 patients operated upon we used tri-bromethanol (avertin), 80 milligrams per kilogram, in amylene hydrate rectally together with local infiltration of procaine hydrochloride. There was 1 bad result in this group which will be described later. Two operations were satisfactorily performed under spinal anesthesia. It is our conviction that these patients can be operated upon most safely with "twilight sleep" supplemented by local infiltration with procaine hydrochloride.

Following laminectomy the patients are kept flat on their backs for the first 8 hours and then are turned regularly every 2 hours. A specially resilient hair and rubber mattress has been found more satisfactory than the usual inflated air mattress. The diet is increased as tolerated. For pain during the first 2 or 3 days 0.02 gram of dilaudid is given, after which it is no longer necessary. Routinely, patients sit up in bed on the tenth postoperative day, sit in a chair on the eleventh day, and are usually discharged on the twelfth to fourteenth day after operation. In rare instances it was necessary to catheterize patients for from 1 to 3 days. The incidence of this complication, however, was no more frequent than after any major surgical procedure. Catheterization has been avoided completely in recent cases by the administration of 0.00012 to 0.00025 gram of carbaminoylcholine chloride (Doryl) before the bladder has become overly distended, resulting in prompt evacuation. In those patients in whom the back has been weakened appreciably by an extensive removal of bone, especially if the patient is a manual laborer, or if

the annulus fibrosus is badly disrupted, a Williams' low back brace is fitted before the patient leaves the hospital and is worn constantly except when in bed. The brace is usually discarded after 2 months.

PATHOLOGY

Herniated nucleus pulposus Maurel has aptly compared the intervertebral disk to one of the more mobile joints. The laminae of cartilage applied to the faces of the vertebra are the articular surfaces, and the annulus fibrosus is the tough joint capsule. Although the space containing the nucleus pulposus is not lined with synovial membrane, it corresponds functionally to the joint cavity with the nucleus pulposus loosely attached within. All motion takes place by movements of the cartilaginous laminae in relationship to each other and to the nucleus pulposus.

Histologically, it is easy to differentiate these 3 structures of the disk. The cartilaginous laminae are true hyaline cartilage. The annulus fibrosus is composed chiefly of dense parallel connective tissue bundles, interspersed with bits of fibrocartilage. The nucleus pulposus is not uniform throughout. In its interior are fine fibers interlacing in all directions with a few islands of cartilage cells. At the periphery the fibers become more concentric in arrangement so that there is a transition to the structure of the annulus fibrosus.

The surgical specimens of herniated nucleus pulposus stained with hematoxylin and eosin show a characteristic structure much like that of the normal nucleus pulposus. The sections stain a pale blue or purple and show the presence of many interlacing, fine fibers running in all directions. Cells are of the type found in cartilage, usually sparse, but placed in groups of from 2 to 6. The nuclei are rounded, take a uniform deep blue stain and are surrounded by a moderate amount of clear cytoplasm. Frequently many of the nuclei are degenerated.

We believe that significant protrusion of the intervertebral disk into the neural canal is almost always due to herniation of the nucleus pulposus even when the annulus fibrosus has been severely disrupted. Nuclear material was found in all of our surgical specimens but

was accompanied in 5 instances by torn fragments of the annulus fibrosus. We believe therefore that the term "herniated nucleus pulposus" is the proper designation for this clinical and pathological entity.

Hypertrophied ligamentum flavum. The ligamentum flavum is probably damaged by injuries similar to those affecting the annulus fibrosus. At operation the normal yellow ligament may be found replaced by white connective tissue making it several times the thickness of the normal ligament which is found above and below the hypertrophied area. The thickened ligament may be partially calcified.

Microscopically the occurrence of scarring is easily apparent. In addition there has been in many cases a low grade inflammatory reaction in the ligamentum flavum. An apparently thickened ligament should not be considered hypertrophied ligamentum flavum unless the microscopic examination shows scarring.

Neoplasms. The diagnosis of dermoid tumor was based upon the finding of a caseous mass filled with hair lying in the cauda equina. The specimen did not include the nodule from which this must have arisen. Possibly the nodule was farther down in the sacrum in an area unexposed at operation. There was no true attachment of the mass to the nerve roots among which it was found.

The epidermoid tumor was diagnosed grossly from the typical pearly gray laminated debris contained in a thin membrane. Microscopically the membrane was composed of cornified stratified, squamous epithelium without dermal elements.

The third tumor presented parallel bundles of fibers with elongated deeply staining nuclei interspersed frequently in palisade formation characteristic of a neurofibroma.

RESULTS

Herniated nucleus pulposus. The immediate result in 26 of the 35 cases of herniated nucleus pulposus was excellent. The improvement was slow in 7 cases but with definite relief of the more severe pain which had occurred before operation. One patient died too soon after operation to judge whether or

not there was any relief, and 1 patient, who was relieved completely of his pain, died on the twelfth postoperative day. The final result in 26 of the 33 surviving patients who have remained entirely free from pain, was excellent. There was some residual weakness of the anterior tibial muscle in 2 instances in which pain was completely relieved. Three patients were relieved of their most severe pain but continued to have some residual pain in the back although free from the sciatic pain which was present before the operation. One patient who had been relieved immediately following the operation and remained so for a period of 2 or 3 months again gradually developed severe pain through the perineal region and the lower extremities. When this patient was re-explored arachnoidal adhesions were found to have caused a complete block of the subarachnoid space at the site of the previous operation. One patient has been entirely relieved except for 2 attacks of severe back pain each lasting 1 week. This patient also has slight residual weakness in the anterior tibial muscle but is entirely free of his old sciatic pain. One patient returned 3 months after operation with sciatic pain in the opposite leg despite the fact that a hemilaminectomy was performed and the dura was not opened. He was completely relieved of symptoms on the side operated upon.

The longest postoperative period through which a patient has been followed is 18 months the shortest 6 months. It is apparent therefore, that the eventual results may not be the same as they appear at present.

Hypertrophied ligamentum flavum. In the hypertrophied ligamentum flavum group consisting of 13 patients the immediate result was very satisfactory in 9 instances. One patient died from meningitis following operation. Of the surviving 12 patients 8 recovered completely and 4 have slight residual pain but are much improved over their preoperative state. The longest postoperative period in this group is 2½ years the shortest 6 months.

Neoplasms. Two of the patients of this group recovered completely and have remained well. The third continues to have mild discomfort in the region of the sacrum,

presumably due to incomplete removal of the dermoid tumor

Negative explorations Four of the 9 patients of this group were relieved almost immediately by the operation and 4 more have slowly improved. Six of the 9 patients are at present free from symptoms, 2 are moderately improved, and in 1 case there has been no modification of the patient's severe back pain.

It is necessary to go into considerable detail in the 9 negative explorations in order to emphasize the points by which they may have been predicted. In 3 instances only was there a filling defect to lipiodol. In one of these it was attributed after operation to the straightness of the lumbar spine which tends to make possible the appearance of spurious defects in the lower canal comparable to those normally seen higher up (Fig 5). In 4 cases there was an asymmetrical or absent axillary pouch. The lipiodol examination was omitted in 1 patient following its extradural administration. In 1 case exploration was done in the face of a negative fluoroscopic examination because of the typical sciatic pain, absent ankle jerk, and hypesthesia of the lateral aspect of the calf. Careful exploration in this case revealed nothing more than an extremely large plexus of veins about the first and second sacral root sleeves on the painful side. The other patients in this group had symptoms and findings typical of herniated nucleus pulposus, namely, typical sciatic pain, diminished ankle jerk, and hypesthesia of the lateral aspect of the calf and foot. In 1 of these 2 patients there was lumbarization of the first sacral vertebra on the painful side, with fusion on the non-painful side, but with an intervertebral disk between the first and second sacral vertebrae. When no herniated nucleus pulposus was discovered, it was thought probable that the compression might be in the bony foramen because of the congenital anomaly. For this reason the dura was opened and the posterior root of the first sacral nerve separated and divided. This has resulted in a complete recovery.

It seems reasonable to assume that in some of the negative explorations, when typical symptoms of herniated nucleus pulposus were



Fig 5 Lipiodol is shown balanced across the fourth lumbar interspace in a figure resembling an hour glass. This patient showed at operation a rather prominent intervertebral disk but no true herniation. This broad bilateral defect does not indicate an intraspinal lesion.

present, relief was obtained by removing a normal ligamentum flavum, thus decompressing the nerve roots which were impinged upon. This is especially apt to be the case when the herniation is of the type which is reduced by the prone position and compresses the nerve roots only when the spine bears weight. It is feared that in this type of case symptoms are apt to recur.

Fatalities There were 3 deaths after operation in the 60 patients operated upon, or 5 per cent. All 3 deaths occurred in patients in their sixtieth year or older. One patient died on the fifth day following operation as a result of meningitis following a wound infection. One patient had a long standing cardiovascular disease before operation and a mild hemiparesis. He developed a complete hemiplegia after operation, succumbing in 48 hours. He had been given tribromethanol, 0.080 gram per kilogram in amylene hydrate rectally, and local anesthesia. A man 60 years of age, who had had no previous colonic disorder was given rectal ether, namely, 90 cubic centimeters of ether in 100 cubic centimeters of olive oil before operation. In addition, local anesthesia was administered for

the operation. After the operation was completed the large bowel was irrigated with saline to remove any of the ether and olive oil mixture which might have remained. During the first 10 days following the operation he complained of abdominal discomfort and gas. Then it became evident from the abdominal distention that a serious intra abdominal complication was present. He died on the twelfth day and it was found at postmortem examination that the large bowel from the middle of the transverse colon to the anal canal was gangrenous containing as many as 30 perforations through which the finger could be passed.

Elderly individuals particularly those with complicating diseases were operated upon only when completely incapacitated. The increased risk which the operation carried was explained to each patient and his family and only in those patients in whom the pain was so severe that they were willing to accept the additional risk was the operation carried out.

DISCUSSION

In nearly all the cases of herniated nucleus pulposus or hypertrophied ligamentum flavum pain has been the disabling factor. Pain in the whole sciatic distribution has been the most useful symptom diagnostically yet a number of proved cases have had pain limited to the back, gluteal region or posterior thigh. Other patients have shown incapacitating backache recurring over a period of several years before a true sciatica occurred. If a herniated nucleus pulposus was present throughout the entire period it is surprising that leg pain was the last occurrence. Maurel has suggested that the herniation probably occurs gradually over a period of months or years giving a characteristic sciatica only when it is complete. This conception corresponds to some of the partial herniations we have seen at operation. Perhaps it would be more logical to suggest that the herniation proceeds in stages a small additional amount of nucleus pulposus being herniated at intervals, giving the intermittent history so characteristic of this clinical entity. Certainly many patients with complete anesthesia in the first and second sacral dermatomes have

pain which is much more severe in the gluteal region or posterior thigh than in the leg. In our experience paresthesias as well as pain have preceded anesthesia in these dermatomes and in rare cases the most severe pain has been referred to the dermatomes corresponding to the root involved. But as a rule this expected sequence is not observed. The roots which are found involved by herniated nucleus pulposus or hypertrophied ligamentum flavum of the fourth or fifth interspace are the fourth (Fig 6) and fifth (Fig 7) lumbar and first and second sacral and perhaps the third fourth and fifth sacral. While these roots supply dorsal divisions to the gluteal region their dermatomes are essentially below the knee with the exception of the second sacral nerve which also supplies the posterior thigh.

Barr concluded that the referred pain from herniated nucleus pulposus has no obvious relationship to the sensory dermatomes. Many of his patients at least 90 per cent had pain in the posterolateral calf. We are of the opinion that this readily agrees with the frequent involvement of the first and second sacral nerves usually at the lumbosacral disk but also at the fourth lumbar disk in some instances. As Foerster has pointed out the involvement of a single root does not produce anesthesia. In those cases with only one root involved a part of the pain or paresthesia complained of is usually in the dermatome corresponding to the involved spinal nerve. Over two thirds of our cases of herniated nucleus pulposus have had hypesthesia or anesthesia of the lateral calf corresponding probably to involvement of the first and second sacral nerves.

In regard to the production of pain by a herniated nucleus pulposus there arises the question upon what factors the pain depends. In one patient paralysis of the anterior tibial muscle preceded pain. We have observed 2 patients in whom sciatica of severe degree was terminated at the appearance of an enduring foot drop years before. A far more common occurrence is the absence of the ankle jerk after a sciatica has ceased to cause pain. When true neuritis subsides the reflexes as a rule return. Therefore these

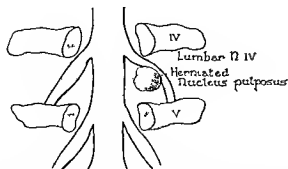


Fig 6 The nucleus pulposus has herniated from the fourth lumbar intervertebral disk far laterally to compress the fourth lumbar nerve. Such a protrusion does not indent the dura but may cause a choked root.

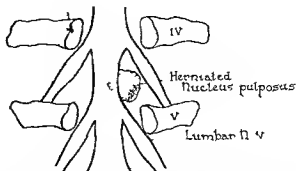


Fig 7 A herniated nucleus pulposus from the disk between the fourth and fifth lumbar vertebrae has compressed the thecal sac on the right. The fifth lumbar nerve is compressed intrathecaly in this instance.

cases of subsidence of an enduring "sciatica" with residual neurological findings indicate the possibility of painful disability from a herniated nucleus pulposus disappearing with complete physiological destruction of the involved nerve.

There are several possible ways of explaining the intermittency of symptoms from herniated nucleus pulposus or hypertrophied ligamentum flavum. A herniated nucleus pulposus is usually situated dorsal to at least a part of the intervertebral disk. We know that it may shift its position beneath the posterior longitudinal ligament because we have observed such shifts at the operating table. It seems probable that a herniation may be reduced by being squeezed back into its original site only if the anatomy of the disk is very grossly altered. Also, without a shift of the displaced nucleus the impinged nerve roots might readjust their position over its glistening surface. One must consider also the possibility that further trauma to already traumatized nerve roots may render them temporarily incapable of conducting painful impulses.

Deucher and Love, in 1938, have described edema of the protruded portions of the intervertebral disks which they feel may cause the intermittent symptoms characteristic of this condition. In the examination of our surgical specimens from the intervertebral disks edema was not considered a prominent feature. Osteopathic or chiropractic manipulations which have undoubtedly given temporary relief to several of our patients, may well do so by one of these mechanisms.

It appears worthwhile to attempt to explain the distribution of pain in the usual case of herniated nucleus pulposus or hypertrophied ligamentum flavum with pain in the back, gluteal region, posterior thigh, and leg. It seems highly probable that the initial pain in the back occurring at the time of injury, was due to tearing of either the annulus fibrosus or the ligamentum flavum, or both. Continued pain in the back is probably due to local stimulation of pain fibers in the region of the lesion, possibly to distention of the small defect in the annulus fibrosus through which the nucleus pulposus is being extruded. As Goldthwaite commented, a thin disk may change the relationship of the articular facets and produce pain by so doing. Since the involvement of a single nerve (usually fifth lumbar or first sacral) by a herniated nucleus pulposus at the fourth or fifth lumbar interspace may cause pain in all the areas mentioned, the explanation must be adequate for this situation. A simple explanation lies in the multiple sensory innervation of the sacrospinalis, gluteal, hamstring, and leg muscles by the fifth lumbar and first sacral nerves. In contrast, the iliopectas, quadriceps, femoris, and adductor groups receive no innervation from these nerves and are never painful in lesions of the disks or ligaments at this level. In addition, there is no way of excluding the overflow of painful stimuli into segmentally adjacent spinal nerves. If the sensory portion of the posterior divisions of these nerves is involved, pain or paresthesias should be referred to the small dermatomes about the gluteal region.

Vaffziger, Inman and Saunders have recently made an important contribution on the mechanisms involved in the production of herniation of the nucleus pulposus and hypertrophy of the ligamentum flavum. These authors emphasize the deficiency of the posterior longitudinal ligament especially laterally where the disk comes into relationship with the intervertebral foramen. Another factor mentioned is the normal location of the nucleus pulposus in the lumbar region a little dorsal to the center of the disk with movement farther dorsally in flexion of the lumbar spine. The intimate relationship between the ligamentum flavum and nerve root is clear since the ligamentum flavum and intervertebral disk form a groove occluding the lower one half of the bony intervertebral foramen. The limitation of rotation in the lumbar region causes lateral flexion to occur when rotation is attempted. This places the major stress upon the posterolateral portion of the annulus fibrosus and the ligamentum flavum of the contralateral side. The authors have seen patients who felt a sudden snap in the back at the time of a probable rupture of the ligamentum flavum. It is the subsequent repair which causes hypertrophy of the ligamentum flavum with encroachment upon the intervertebral foramen.

It is surprising that the articles dealing with one aspect of low back pain and sciatica rarely mention the other aspects although from the symptomatology the cases doubtlessly come within the same group. Anomalies of the lower lumbar and sacral spine doubtlessly cause incapacitating symptoms at times. But they are observed so frequently as coincidental findings in the absence of symptoms that their presence in particular instances should not be invoked too readily to explain the disability. Excellent descriptions of such anomalies are given by Wagner and by Clarkson and Barker. It is necessary to emphasize that anomalies of the lumbosacral spine may be accompanied by weakness of the annulus fibrosus or ligamentum flavum. Also due to the altered mechanism predisposition to herniation of the nucleus pulposus or tearing of the ligamentum flavum with subsequent hypertrophy may well exist.

There is so little evidence that fascial constrictures exist primarily, except perhaps in very unusual cases, that they can be dismissed as common causes of low back pain and sciatica. On the other hand Freiberg believes that the anatomical situation of the sciatic nerve between the piriformis muscle and the sciatic notch is similar to the position of the brachial plexus in the scalenus angle. He indicates that the relief in these cases afforded by section of the piriformis muscle or the fascia lata tends to prove this point. In this connection it is interesting that many cases of tuberculosis and metastatic carcinoma of the cervical spine show characteristic symptoms and signs of scalenus neurovascular compression (11) including scalenus tenderness and reproduction of pain and paresthesias by pressure over the scalenus anticus muscle. These patients, of course have been treated etiologically rather than with anterior scalenotomy. However, it seems probable that the amelioration of symptoms in cases of low back and leg pain which have been subjected to section of the ileotibial band or the piriformis muscle might be analogous to a scalenotomy in such a case. There is no denying temporary improvement following this procedure in a moderate percentage of cases but in our experience the symptoms have recurred and after lipidol studies indicated the location of the lesion a herniated nucleus pulposus or hypertrophied ligamentum flavum was surgically verified and removed. Barr reports that 2 of his patients with surgically treated herniated nucleus pulposus had previously been relieved for 12 months and 2 months by fasciotomy. Five of our patients had previously been subjected to fasciotomy but only 1 of them obtained even temporary relief of symptoms. Ober in reporting 13 cases of fasciotomy with relief in 12 instances makes this statement. Before the surgeon does this operation he should be very sure that there is no pathologic condition in the spinal canal especially in the region of the cauda equina. Since his cases are clinically identical to many that have been proved to be herniated nucleus pulposus it is clear that the only way in which the surgeon can rule out intra

spinal etiology is by fluoroscopic studies utilizing intraspinal lipiodol. If conservative treatment or fasciotomy gave lasting relief in cases of herniated nucleus pulposus, laminectomy would probably be replaced, even though the treatment would not attack the etiology. However, our experience indicates that lasting relief of pain can be obtained only by removal of the actual intraspinal pathology.

Smith Petersen explains the frequent radiation of pain from the lumbosacral joint to the dermatomes of the fifth lumbar and first sacral nerves by the fact that the lumbosacral joint receives its innervation from these 2 spinal nerves. This radiation of sciatic pain is, again, highly suggestive of herniated nucleus pulposus. That the pain of herniated nucleus pulposus or hypertrophied ligamentum flavum may be relieved temporarily in many instances by operations directed toward the fasciae, the sacro iliac joint, the lumbosacral joint and its articular processes, or by traction or immobilization of the lower spine, seems highly probable. It appears, however, very unlikely that these measures will bring about enduring relief. The solution appears to be in subjecting this entire group of patients to lipiodol studies provided that disability is sufficient to justify an operative procedure.

SUMMARY AND CONCLUSIONS

1 Of the 3 pathological conditions described in this paper, herniated nucleus pulposus is by far the most frequent. While the true incidence of this condition is as yet unknown, the occurrence of 35 cases during the same period in which 3 tumors of the cauda equina were observed indicates its probable frequency.

2 The diagnosis of herniated nucleus pulposus or hypertrophied ligamentum flavum

must be made clinically as well as roentgenologically to assure successful selection of cases for operation.

3 The use of 2 cubic centimeters of lipiodol intraspinaly is a safe procedure and the amount is adequate for diagnosis.

4 Lesions low in the spinal canal are the commonest single cause of recurrent or chronic low back and sciatic pain in that group of patients in whom no bony disease of the lower spine or pelvis is demonstrated.

BIBLIOGRAPHY

- 1 BARR J S. Sciatica caused by intervertebral disc lesions. A report of forty cases of rupture of the intervertebral disc occurring in the low lumbar spine and causing pressure on the cauda equina. *J Bone & Joint Surg* 1937 19 323.
- 2 CLARKSON W and BARKER A. Lumbosacral anomalies as a cause of low backache. *South M J* 1938 31 5.
- 3 DEUCHER W G and LOVE J G. Posterior protrusions of the intervertebral disks. Pathologic-anatomic aspects. *Proc Staff Meet Mayo Clin* 1938 13 44.
- 4 FREIBERG A H. Sciatic pain and its relief by operations on muscle and fascia. *Arch Surg* 1937 34 337-350.
- 5 GOLDTHWAITE J E. The lumbosacral articulation. An explanation of many cases of lumbago, sciatica and paraplegia. *Boston M & S J* 1911 164 365.
- 6 LASÈGUE C. Considération sur la sciatique. *Arch gén de méd* 1864 2 558.
- 7 MAURIC G. Le disque intervertébral. Paris Thèse 1933.
- 8 NAFFZIGER H C, FRYMAN V and SAUNDERS J B. De C M. Lesions of the intervertebral disc and ligamenta flava. *Surg Gynec & Obst* 1938 66 288-299.
- 9 OBER F R. Back strain and sciatica. *J Am M Ass* 1935 104 1580.
- 10 SMITH PETERSEN M N. Routine examination of low back cases with particular reference to differential points between lumbosacral and sacro iliac regions. *J Bone & Joint Surg* 1924 6 819.
- 11 SPURLING R G and BRADFORD F K. Scalene neurocirculatory compression. *Ann Surg* 1938 107 5.
- 12 WAGNER L C. Congenital defects of lumbosacral joints with associated nerve symptoms. *Am J Surg* 1935 27 371.
- 13 WILLIAMS PAUL C. Lesions of the lumbosacral spine. *J Bone & Joint Surg* 1937 19 343.

TRAUMATIC ENOPHTHALMOS

CARL W. RAND M.D. F.A.C.S. and DAVID L. REEVES M.D.
Los Angeles, California

AMONG the uncommon effects of head injuries few are perhaps more striking than traumatic enophthalmos. Ordinarily its infrequent occurrence and peculiar progress is sufficient to arouse the interest and curiosity of any examiner first encountering a case for diagnosis. Such was found to be true in the presented examples of this unusual condition.

As early as 1893 Schapring called attention to the fact that cases of dislocation or violent backward displacement of the eye should be distinguished from those of true enophthalmos or recession of the eye following an injury. Although presuming that many more cases of traumatic enophthalmos of varying degree have occurred than have been reported its relative infrequency is shown by the fact that at the time of his paper in 1902 Kilburn was able to collect a total of only 31 cases. In a comprehensive article on the subject in 1906 Lukens gathered together 78 cases to which he added 1 of his own. Hartung tabulated 14 cases of traumatic enophthalmos among 50,000 patients in the ophthalmic clinic in Jena while in the Leipzig Clinic of 150,000 admissions the condition was observed only 4 times. In 1930 Birch-Hirschfeld was able to collect 164 cases from the literature. He mentioned that Pichler had seen not less than 28 cases during 3 years of the world war. Wagenmann had discovered 14 cases over a period of 10 years and he himself had observed 5 cases during a period of 3 years.

REPORT OF CASES

CASE 1 Recession of the left eye occurring a year following an automobile accident 13 years previously slowly progressive since that time. Left frontal headaches and occasional blurring of vision of the left eye for the last 2 years.

The patient Mrs. J. D. K., aged 39, was referred by Dr. L. F. Brown of Corona, California, because of slowly progressive recession of the left eye for 13 years together with left frontal headaches and blurred vision of the same eye for the last 2 years.

Her subsequent history revealed an automobile accident sometime in 1924 which resulted in no loss of consciousness, no bleeding from the ears or nose and no apparent sequelae other than the condition which brought her for examination and diagnosis. As far as the patient could remember it was a year or more after the accident that she first realized her left eye appeared more deeply set than the right. Since then the recession has slowly but progressively increased. About 2 years ago for the first time a dull throbbing headache occurred in the left frontal region which has since returned about twice a month. The duration of this headache has varied from 2 to 3 hours to the entire afternoon. During the past 2 years she has also noticed some blurring of vision in the left eye lasting usually about 1 to 3 hours. This she has felt has not had any particular relation to her headaches. No nausea or vomiting has been associated with her illness. No relative has ever had a similar condition and the family history was otherwise without significance.

The patient's general health has always been good. She has been married 8 years. Her husband and 2 children, a girl of 7 and a boy of 3, are living and well. Her blood Wassermann was negative and a review of the systems was found to be non-contributory.

Examination revealed a woman 5 feet 5½ inches tall, weighing 130 pounds, who appeared to be in good physical condition. About 4 centimeters to the left of the midline in the frontal region a linear scar about 6 centimeters in length was observed extending upward from the eyebrow toward the hair line. This gave the appearance of an old laceration (Figs. 1 A and B). It was not particularly painful nor sensitive to pressure. Strangely enough on further questioning concerning this the patient was unable to recall that it had occurred as a result of her injury. In comparison with the right the left eyeball was markedly recessed and seemed higher in the socket. A slight ptosis was noticeable and the left eye had the suggestive appearance of an artificial eye. There also appeared to be some atrophy of the infra-orbital region, particularly toward the nasal side (Fig. 1). The contours of the head were otherwise normal and no areas of tenderness were noted. The general physical examination revealed nothing of importance.

Examination of the cranial nerves disclosed nothing of pathological interest. She recognized camphor in each nostril. Both optic discs were clearly seen, were normal in color and showed no evidence of papilledema. The vessels appeared normal in caliber and no hemorrhages or exudates were seen.

The uncorrected vision of the right eye was 20/30 and the left 20/40. The pupils were circular and equal and reacted well and equally to light and accommodation. The extra ocular movements were well performed; there was no nystagmus, squint, or diplopia. Both corneal reflexes were found to be equal and active, and no motor or sensory disturbances were made out. Similarly, normal performances were elicited from the remaining cranial nerves. No constriction of the visual fields was found on rough testing and further perimetric examination with the Bjerrum screen confirmed these findings. The remaining neurological examination revealed nothing of a pathological nature.

Roentgenograms of the skull with special reference to the optic foramen were taken by Dr. R. G. Karshner. They failed to reveal any demonstrable intracranial abnormality. The optic foramina were well shown and equal. The sella turcica was rather small and of the somewhat closed type.

There are features of this case not unlike those of progressive facial hemiatrophy which will be considered in the discussion.

CASE 2 Laceration over left eyebrow 3 years previously when he was hit in this region by a bottle. Patient has not noticed any particular difference in the position of the eyeball.

The patient Mr. V. P. M., aged 44, injured his left eye some 3 years previously when he was struck over this region with a beer bottle which resulted in momentary loss of consciousness and a laceration above the left eyebrow requiring 5 stitches. The patient is of the opinion that he has not seen as well with this eye since the injury, but has not observed any particular difference in the position of the eyeball. He was knocked unconscious for about an hour as a result of an automobile accident during January of 1937. There were no hemorrhages from the ears and x-ray films failed to reveal evidence of a fractured skull. About 2 or 3 months following the injury a tremor of the right arm and shoulder appeared which has persisted. Diplopia, which was noticed immediately after the accident, gradually cleared up with the exception of persisting for upward gaze. He has not suffered with headaches nor has he complained of dizziness. At times he has some shaking of his right leg. He has been unable to walk, but has been able to stand by holding on for support. His general health has always been good. A review of his family and past history disclosed nothing of importance. The blood Wassermann was found to be negative.

On examination the patient exhibited a rhythmical tremor of the right upper extremity most marked about the shoulder but affecting the entire arm. No typical pill rolling effect was observed. His features though rather expressionless were not definitely mask like. The tremor of the hand was not found to be diminished with use. The left eyeball was noticeably sunken in the socket as compared with



Fig. 1. Case 1. A Left Front view of patient showing the scar crossing the left eyebrow into the frontal region and the enophthalmos of the left eye. B Partial side view of the same patient.

the right. A scar was observed about midway in the upper eyelid crossing the supra-orbital region and extending about 3 centimeters into the forehead (Fig. 2). There seemed to be no increase and no difference in the intra-ocular tension of the 2 eyes. Both pupils reacted sluggishly to light, the left more than the right. They reacted well to accommodation; there was no diplopia and no observable squint and both fundi appeared normal. The watch tick was heard at a distance of 4 inches from the right ear, and only when pressed against the left ear. Bone conduction was better than air conduction on the right side and air conduction better than bone conduction on the left. The Weber was not referred. The cranial nerves were otherwise found to be normal. Coordination tests could not be carried out well, but it was noticed that his tremor did not stop during the performance of the finger-to-finger or finger-to-nose tests. The Romberg and gait were not tested as it was evident he could not stand in the Romberg position and was not able to walk without support. There was a strongly suggestive Babinski bilaterally. The deep reflexes were found to be equally active. The vasomotor reaction was markedly increased. The patient's cerebation was generally slow and his insight poor.

It was felt that the patient had developed a Parkinsonian type of tremor of the right upper extremity with a paresthesia of this extremity and hand suggestive of a thalamic lesion. It was assumed that most of his symptoms were of a posttraumatic nature. The recession of the left eye was believed typically that of traumatic enophthalmos, due in all probability to his first injury.

CASE 3 Automobile accident 3 months previously in which patient struck her left frontal region on the



Fig. 2. Case 2. A Front view of patient revealing somewhat indistinctly the scar running from the left upper eyelid into the forehead. The recession of the left eyeball is not well shown in this view. B Light and left side views of the same patient. The scar is more noticeable and likewise the enophthalmos. In this view the prominence of the left external angular process is evident.

dashboard. Momentarily unconscious. Laceration through left eyebrow and comminuted fracture involving the anterior wall of the frontal sinus. Recession of the left eyeball noticed about 1 month later. Aneurism of the left external carotid artery traumatic.

The patient Mrs. W. J. L., aged 37, injured her left eye and frontal region August 1, 1938, in an automobile accident in which her head was thrown against the dashboard. She was knocked unconscious for a few minutes and was dazed for a short time thereafter. She was nauseated, vomited a few times, and had some headache. Examination at the Los Angeles County General Hospital revealed a severe hematoma of the left frontal region with swelling and ecchymosis of the lids of both eyes, the left being more pronounced. There was also a hematoma near the outer canthus of the left eye as well as subconjunctival hemorrhage. In addition there was a deep and jagged laceration running perpendicularly from the left eyebrow into the forehead for a distance of about 3 centimeters. An underlying fracture line was felt when this was probed. Shortly after the accident the patient complained of a constant buzzing throbbing sensation in the left temporal region. Following her discharge on August 8, 1938, she was readmitted September 18, 1938, because of the continuance of this throbbing buzzing sensation. For a week prior to her admission she had had some frontal headache but no nausea, vomiting, or dizziness. Auscultation of the skull over the left temporal region revealed a definite bruit. This could be stopped by pressure over the left carotid artery. Roentgenograms of the skull taken September 20, 1938, showed a comminuted fracture involving the anterior wall of the frontal sinus which included depression of this bone at its suture with the nasal bone. The nasal bones were also fractured with depression of the adjacent portion of the frontal bone. A basal view of the skull taken on September 22, 1938, revealed both jugular foramina but showed no evidence of erosion due to

aneurism. Roentgenograms of the optic foramina taken October 6, 1938, were found to be negative. Blood and spinal fluid Wassermann tests were negative. Examination of the visual fields showed them to be essentially unrestricted and the uncorrected vision of each eye was 20/20 on the right and 20/40 on the left. The fundi appeared normal and the remaining cranial nerves revealed no abnormalities. The general neurological and physical examination was essentially negative.

The slight enophthalmos of the left eye was noticed first on September 26, 1938, and seemed to become slightly more pronounced during her further stay in the hospital (Fig. 3). Parenthetically it may be stated that when the patient's attention was called to a possible difference in the prominence of her eyes she immediately said that she had noticed her left eye was sinking. She was very positive on this point.

Examination of the eyes revealed a definite recession of the left. This was emphasized by the scar in the eyebrow and forehead and the apparent undue prominence of the external angular process (Fig. 3). There was no noticeable difficulty with the extraocular movements of the eye. No visual disturbances were present. Both pupils were circular and equal. They reacted normally to light and distance.

Daily pressure on the left common carotid artery was carried out and on October 31, 1938, this vessel and its branches were exposed. Occlusion of the internal carotid failed to alter the bruit but occlusion of the external completely abolished it. The external carotid was consequently ligated with disappearance of the bruit.

As far as we can demonstrate this is the only case that showed fractures in the vicinity of the orbit. It is entirely possible that Cases 1 and 2 may have had fractures which subsequently healed. We feel that the enophthalmos and the intracranial aneurism in this in



Fig 3 Case 3 A Front view of patient which demonstrates the scar in the left eyebrow and forehead and the prominence of the left external angular process. The enophthalmos is not well visualized in this view B Right and left side views of the same patient The enophthalmos is more evident in this view

stance represent separate entities. It is probable that the enophthalmos will increase with the passage of time.

SYMPTOMATOLOGY

According to Wurdemann, in his excellent summary of the condition, the patient usually related that sometime following a contusion of the orbital region, a gradual recession of the involved eye occurred. In 14 cases reported by Hartung the enophthalmos appeared within a week after the injury in 3, while in the 11 remaining it developed after months and even years. In a few cases subjective symptoms of a foreign body in the eye, more often of anesthesia of the nose, cheek, and lips on the injured side, caused by damage of the intra-orbital nerve and infraction of the orbital floor have been described. Denig reported a case in which paresthesia occurred in the region of the trigemini and on the injured side of the face.

Not uncommonly a scar is conspicuous in these patients. Almost invariably this involves the eyebrow, and sometimes it is painful to pressure. Not infrequently the upper lid droops and is less convex on the affected side, the palpebral fissure is narrowed, and the retrotarsal depression is deeper. When examined, the eyeball ordinarily is of normal size although the space between the orbit and the hulk is enlarged. Praun has compared the

appearance of the eye in these cases with that observed in people with artificial eyes. There is as a rule full movement of the globe except in cases in which paralysis or fracture of the skull has occurred, binocular vision remains intact. Examination of the intra-ocular tension and fundus usually reveals nothing abnormal.

PROGNOSIS AND PATHOLOGY

According to Wurdemann further recession of the eyeball occurs in many cases. In the majority the visual acuity remains unchanged, but in a few instances vision becomes impaired even to the point of blindness.

Although theories advanced to explain the pathological process causing enophthalmos traumaticus have invariably sought to account for the phenomenon by an actual or relative increase in the orbital capacity, the methods given for the production of this effect by advocates of the various theories have been vastly different.

Praun divided cases of traumatic enophthalmos into the trophoneurotic, the cicatricial, and the mechanical forms. He felt that the first type occurred following blows from large objects upon the margins of the orbit or the skull, which caused a sinking of the hulk into the orbit. It was his opinion that a similar condition resulted from the trophoneurotic absorption of the retrobulbar fat as a result of

lesions of the nerve trunks or centers. He accounted for the cicatricial enophthalmos by periostitis of the orbit, which led to a contraction of the connective tissue and the orbital fat. He was of the opinion, moreover, that as a result of these inflammatory processes in the orbit and the cicatricial contraction of Tenon's capsule and the globe became more or less atrophic. Mechanical enophthalmos on the other hand he believed due to a fracture of the orbital walls which generally produced a downward and backward depression of these structures thus allowing the eyeball to recede.

Lederer believed fractures of the orbital walls occurred in all cases of traumatic enophthalmos and that with these fractures hemorrhages into the orbital tissues resulted producing first of all an exophthalmos. The subsequent tearing of the tissues by the hemorrhage caused cicatricial contraction which secondarily produced enophthalmos. Lang was similarly convinced that a fracture or depression of the orbital walls always occurred and felt that inasmuch as the pad of fat was only of sufficient size to fill the retrobulbar part of the normal orbit, it sank into the depression causing a vacuum and forcing the eye back by atmospheric pressure. It was also Gessner's opinion that a mild periostitis and inflammation of the retrobulbar fatty tissue followed the injury and that with the resulting cicatricial contraction of the orbital contents the eye sank backward. In an exhaustive article and study of 78 cases from the literature in addition to one of his own Lukens was of the opinion that when there was no grossly depressed fracture the most rational explanation was that of absorption of orbital fat due to pressure incident to the violent cellulitis confined within the elastic bony cavity. Following subsidence of the intra-orbital swelling the loss of fatty cushion became manifest and the eye receded.

Certain very plausible objections to these ideas have been advanced. As has been mentioned by Shoemaker cicatricial contraction cannot be readily adopted for the reason that the enophthalmos has frequently occurred too soon after the injury. The globe, moreover, is usually freely movable. Not only this but for the theory to be acceptable, enophthalmos

should follow orbital cellulitis, whereas such is not the case. In regard to the theories of Lederer, Lang and others that fracture of the orbital walls is the most probable cause of traumatic enophthalmos, it must be remembered that severe traumatism with undoubted and extensive fracture causing displacement of the eyeball should be considered as such and not as enophthalmos.

When less severe fractures are accepted as the usual explanation of the condition, the fracture, as Shoemaker has suggested, would have to be depressed, for a simple linear fracture would after union, theoretically at least cause a diminution in the size of the orbit, because a certain amount of thickened periosteum and callus would be expected. Notwithstanding the thinness of the orbital walls fractures in this locality usually caused by indirect force are more apt to be linear than depressed. However this might be, it must be admitted for this theory as well as for other similar ones that whereas in the condition contemplated, enophthalmos can and probably does exist, Tenon's capsule must in such cases be the victim of the serious interference and it is damage to Tenon's capsule that seems to furnish the most logical explanation of the pathology of the enophthalmos.

As early as 1881 Talko in summarizing 8 conditions in which enophthalmos had been noticed referred in one of these to the smooth muscle fibers discovered by Sappey in and about the orbit, paralysis or spasm of which he reasoned would cause enophthalmos or exophthalmos, respectively. It was also Fick's opinion, in 1896, that the most probable cause was a laceration or rupture of the connective tissue fibers passing from Tenon's capsule to different points of the orbit and acting as suspensory ligaments of the eyeball. Mention was made also of the orbital fascia by Treacher Collins in 1899. He called attention to the opposition offered by this fascia to the muscle cone within the orbit. At the same time he referred to an interesting congenital case in which autopsy revealed much shortened muscles which were attached too far posteriorly, suggesting the possibility of an absence or misplacement of the check ligaments.

Other than these opinions, Ienon's capsule and check ligaments received little attention as probable elements in the production of traumatic enophthalmos until the comprehensive article of Shoemaker in 1900. As pointed out by him, the anatomical relations of Ienon's capsule with its check ligaments are such that they would seem necessarily involved to a greater or less extent in every case of this condition.

As described so well by Maddox, in 1898, the capsule of Tenon is a fibro elastic membrane or fascia firmly attached anteriorly to the periorbitum surrounding the orbital margin and to the periosteum circumscribing the optic foramen posteriorly, thus forming primarily a cone from which issue numerous subsidiary investing membranes covering in part every structure within the orbit. The check ligaments, which, close to their origin at the marginal insertion of the capsule contain smooth muscle fibers, are thickened bands of fibro elastic material, which are attached posteriorly to the outer layer of the muscle sheath, to the belly of the muscle itself, and to that portion of the fascia investing the posterior hemisphere of the eyeball. All of the ocular muscles seem to be accompanied by check ligaments or their analogues. The involuntary muscle fibers in the check ligaments are, of course, innervated by sympathetic nerves.

The forces which influence the condition of equilibrium of the eyeball may be divided into those acting from a position anterior and posterior to its center of rotation, the former constituting what is known as the muscle cone, or the 4 recti with perhaps the levator, the latter being the 2 oblique muscles and the capsule of Tenon. When considered alone is 2 opposing muscular forces, the recti would have the balance of power and displacement of the eyeball would most likely accompany most contractions of these muscles. Although the orbital fat would lend important support as a cushion or buffer, it is not able to act as a fulcrum around which to change the direction of the applied force. The division of Ienon's capsule, which passes around the posterior portion of the globe and holds the eyeball somewhat in a sling, receives direct attach-

ment from the check ligaments and is of considerable importance, for here resistance to backward pressure is ultimately transferred and traced through the check ligaments to a fixed insertion at the orbital margin. Shoemaker believed that all the forces exerted in ocular movements must terminate in the bones of the orbit, for these movements would be very uncertain and inaccurate if the basis of support itself were unsteady.

It therefore becomes reasonably apparent that Ienon's capsule and the check ligaments must always play an important part, and in some cases the all important part in enophthalmos. Relaxation of the capsule from any cause would permit recession of the eyeball, and a sufficient rupture of the capsule either near the orbital margin or in that division passing behind the globe, or rupture of the check ligaments, if extensive, would almost of necessity be followed by enophthalmos.

That recession does not always follow the injury immediately has been accounted for by the probability that a rupture often is accompanied by hemorrhage which would materially increase the orbital content behind the globe, thus counteracting the loss of an anterior support until absorption has taken place. Indeed, as has been suggested, proptosis might be anticipated as the immediate result of the injury which ultimately leads to enophthalmos.

In considering Bear's theory which contemplated a lesion of the nerve centers or tracts, particularly of the trigeminal sympathetic which he believed resulted in absorption and atrophy of the cellular tissues within the orbit, Shoemaker pointed out that growing such lesions were producible by the traumatism reported, it would seem reasonable to believe they would cause similar changes also in Ienon's capsule, thus robbing it of its power to support the eyeball properly in its normal position. Such seemed particularly applicable inasmuch as the check ligaments contain smooth muscle fibers also under the influence of sympathetic innervation. In this connection it seemed that exophthalmos might be produced in the reverse way by sympathetic irritation causing these muscular fibers to contract.

Zimmerman, finding a persistent reaction with cocaine in his cases, was of the opinion that traumatic enophthalmos without orbital fracture based on the assumption of sympathetic paralysis was a rather dubious supposition.

Whether there be one or several pathological explanations for enophthalmos traumaticus, the result of trauma to Tenon's capsule and the check ligaments as advocated by Shoe-maker and others seems the most logical and the one best suited to explain the condition under varying circumstances.

DIFFERENTIAL DIAGNOSIS

According to Wurdemann the differential diagnosis has to be made occasionally between progressive facial hemiatrophy, phthisis bulbi and microphthalmos. Of these the first originally described by Romberg in 1846 and likewise known as Romberg's disease seems the only one apt to be particularly confusing.

In an excellent review of this condition by Archambault and Iromm in 1932 they were able to gather 400 cases from the literature. Of this group there were about 24 instances of total hemiatrophy and 27 of double facial hemiatrophy. Interestingly enough a history of traumatism preceding the onset of the condition was found in 5 to 35 per cent of the cases. Moreover quite similar to traumatic enophthalmos in the great majority of cases the interval was from 2 to 3 weeks to a few months though in some cases years elapsed between the injury and the onset of the atrophy. They believed it constituted more than a localizing or concurrent factor and that it might be the primary etiological factor though they were cognizant that the actual etiology still remained largely speculative.

In progressive facial hemiatrophy the atrophic process as a rule involves all of the tissues affecting the subcutaneous fat and connective tissues most severely sometimes sparing the skin and much more rarely the bony structures. The facial hemiatrophy may begin at any point such as the region of the orbit about the angle of the mouth or the wing of the nose, over the malar prominence, or along either the vertical or horizontal segment of the mandible. From its point of

origin the atrophic process may spread either gradually or rapidly until the entire half of the face is involved, or it may come to a standstill spontaneously at any stage of its evolution. Although known as facial hemiatrophy, this peculiar dystrophy has in many cases extended to the neck, the upper part of the thorax and arm, and even the entire half of the body. Although the condition occurs ordinarily in early life and especially during the second decade, it may develop at any age even in advanced life.

CORRECTNESS OF DIAGNOSIS

Although there are features of the first case not unlike progressive facial hemiatrophy, the diagnosis of traumatic enophthalmos seems more logical. When in facial hemiatrophy the atrophy is not confined to the orbit but more extensively involves one side of the face, the differential diagnosis is a simple matter.

In a fair percentage of cases, that is 25 to 33 per cent, progressive facial hemiatrophy follows an injury about the cranium face or neck, the atrophy occurring after a length of time quite similar to that of traumatic enophthalmos. In progressive facial hemiatrophy, however, the atrophic process usually involves all of the tissues including the bony structures something not evident in the presented case. Though the facial hemiatrophy may begin at any point, such as the orbital region, the atrophic process usually spreads either gradually or rapidly until the entire half of the face is involved. On the other hand it may come to a standstill spontaneously at any stage of its evolution.

In traumatic enophthalmos further recession of the eyeball occurs in many cases with loss of vision, while in others the visual acuity remains. In the present case, the beginning of symptoms of blurred vision may be an early indication of visual impairment.

Among other things difficult to explain in traumatic enophthalmos is the fact that in the presence of so many head injuries serious and otherwise the condition is so uncommonly observed. Moreover if trauma is accepted as the primary etiological factor in progressive facial hemiatrophy, the same difficulty occurs. In addition to trauma, there must evidently

be some individual peculiarity which is responsible for the infrequent occurrence of these two interesting conditions

If, in the first case, the atrophy and orbital recession, which has been evident for 13 years should spread to involve other portions of the face, the diagnosis of progressive facial hemiatrophy would, of course, have to be conceded. At the present time, however, the diagnosis of traumatic enophthalmos seems correctly designated

SUMMARY AND CONCLUSIONS

1 Three cases of traumatic enophthalmos are reported together with a discussion of their symptoms, objective findings, and prognosis. The condition is compared with that of progressive facial hemiatrophy.

2 It was found that in 1930 Birch-Herschfeld had collected 164 cases of this relatively uncommon condition.

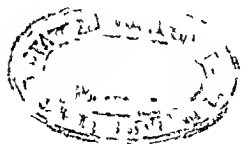
3 All theories advanced to explain the pathological process causing traumatic enophthalmos have invariably sought to account for it by an actual or relative increase in the orbital capacity, but the methods given for the production of this effect by advocates of the various theories have differed considerably.

4 Shoemaker's conception of the usual cause of the enophthalmos being due to a rupture of Tenon's capsule or its thickened bands known as the check ligaments is felt to be the most logical explanation under varying circumstances. This theory and the others most usually advanced are discussed.

5 It is believed that many cases of relatively slight traumatic enophthalmos, especially in their earlier stages, escape observation.

REFERENCES

- 1 ARCHAMBAULT L and FROMM N K Progressive facial hemiatrophy Arch Neurol & Psychiat 1931 21 529
- 2 BEER F Studien ueber traumatischen Enophthalmos Arch f Augenh 1892 25 315
- 3 BIRCH-HERSCHFELD A Zur Genese des traumatischen Enophthalmus Ztschr f Augenh, 1930 72 259
- 4 COLLINS E TREACHER Enophthalmos Brit M J, 1899 2 846
- 5 DENIG R Enophthalmus traumaticus Abflachung der linken Gesichtschaeffte infolge Trigemminusreizung Arch f Augenh 1894 28 276
- 6 FICK A F Diseases of the Eye and Ophthalmoscopy A Handbook for Physicians and Students Philadelphia P Blakiston's Son and Co 1896
- 7 GESSNER C Enophthalmus traumaticus Arch f Augenh 1888 28 297
- 8 HARTUNG K Ueber 14 Falle von Enophthalmus traumaticus Ztschr f Augenh 1910 23 551
- 9 KILBURN H W A Case of traumatic enophthalmos Arch Ophth, 1902 31 384
- 10 LANG W Traumatic enophthalmos with retention of perfect acuity of vision Tr Ophth Soc U Kingdom, 1889 9 41
- 11 LEDERER R Ueber traumatischer Enophthalmus und seine Pathogenese Arch f Ophth, 1902 33 41
- 12 LUKENS C Traumatic enophthalmos with report of a case Ophthalmology 1906 3 30
- 13 MADDOX E E Tests and Studies of Ocular Muscles London and Bristol J Wright and Co 1898
- 14 PICHTER A Beobachtungen ueber traumatischer Enophthalmus in drei Kriegsjahren Arch f Ophth 1918 95 145
- 15 PRAUN L Die Verletzungen des Auges Wiesbaden J F Bergmann 1899
- 16 SCHAPFINGER A Beitrag zur Casuistik des Enophthalmus traumaticus nebst Bemerkungen ueber die Pathogenese desselben Klin Monatsbl f Augenh, 1893 31 399
- 17 SHOEMAKER W T The Relation of Tenon's capsule and the check ligaments to enophthalmos Ann Ophth 1900 9 391
- 18 TALKO J Ueber den Enophthalmos Vortrag gehalten in der medicinischen Section der III Versammlung der polnischen Aerzte und Naturforscher in Krakau von 21 bis zum 25 Juli 1881 Nach dem Referate in den Klin Monatsbl f Augenh 1881 19 471
- 19 WURDEMANN H V Injuries of the Eye P 818 Cleveland Cleveland Press 1912
- 20 ZIMMERMAN C Traumatic enophthalmos Arch Ophth 1897 26 38



BLOOD SUPPLY OF THE MAMMARY GLAND

BARRY J ANSON Ph D (Med Sci), and ROBERT R WRIGHT BA
Chicago, Illinois

Surgical Considerations by John A Wolfer, M D

IN a recent anatomical study of a female cadaver the blood vessels which supply the mammary gland were remarkably well shown¹ Since satisfactory illustrations of the arteries in this region are rare the authors venture to present a brief record of this phase of their investigation The dissections were carried out in serial order, and drawings of the successive levels were prepared at natural size The veins which accompany the arteries need not be described

RIGHT SIDE

INTERNAL MAMMARY ARTERIES

The internal mammary artery arising from the first portion of the subclavian within the neck descends into the thorax under cover of the clavicle and the first rib passing downward behind the cartilages of the succeeding ribs to the level of the sixth intercostal space it divides into superior epigastric and musculophrenic branches (Fig 6)² Of the various branches given off in its thoracic course those which concern the present study are the anterior perforating arteries

1 Anterior perforating arteries Five perforating arteries are present one corresponding to each of the five upper intercostal spaces Arising in serial fashion from the front of the internal mammary and passing through the intercostal muscles they reach the pectoralis major, which they supply through muscular

rami, the terminal twigs of the latter penetrate the muscle close to the sternum, and are distributed to the integument as cutaneous rami (Fig 1) The second third and fourth perforating vessels are usually described as supplying the medial and deep surfaces of the mammary gland In our specimen on the right side, only the first and fourth perforating arteries give laterally directed branches to the breast (see arrows Fig 6), the others have no mammary rami

As is shown in superficial dissection of the mammary tissue, the mammary rami of the anterior perforating branches constitute the chief supply of the breast (Fig 1) The first perforating branch courses lateralward to the superior margin of the breast, there dividing into parallel rami (Fig 1, *a* and *b*) and supplying by numerous offshoots the cephalic fourth of the right breast, the main channels join again at the axillary margin, anastomose with the mammary ramus of the lateral thoracic artery (Figs 4 and 5) Proximal to the division into mammary rami the first perforating artery gives off two twigs one directed upward the other downward The fourth perforating branch is a strong stem branches of which pass cranial to the nipple (Fig 1, *b* and *c*), they are terminal and do not anastomose with axillary stems Proximal to the division branches of medium caliber are given off two upon the breast (Fig 1, *a* and *d*) and one along the inferomedial margin (Fig 1, *e*)

In addition to these, near the sternum a branch is sent downward to anastomose with the perforating artery next below Of the other perforating branches only the fifth affects the mammary area and indirectly by anastomosing thinly with the fourth The mammary rami course in the most superficial portion of the fatty pannicle giving off finer

¹ The specimen is a nulliparous negro woman 30 years of age 5 feet 3 inches in height weighing 72 pounds (embalmed) The specimen was employed in a recent study of the envelopic fascia of the female pelvis (Curtis A H Anson B J and McVay C B Surg Gynec & Obst 1939 68 161-166)

² The musculophrenic artery leaves the internal mammary at the sixth intercostal space finally reaches the eighth it sends an anterior intercostal to the seventh and eighth spaces and a phrenic branch to the diaphragm but gives none of the mammary supply

Contributed on May 28, 1941 from the Anatomical Laboratory of Northwestern University Medical School

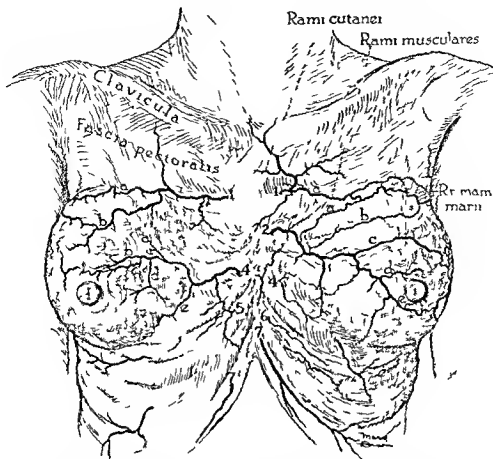


Fig. 1 Mammmary rami of the anterior perforating arteries. One third natural size. Except in the mammmary region, the superficial fascia has been removed to show the course of the arteries. The numbers indicate the intercostal rami of the perforating arteries.

twigs which penetrate the breast to varying depths.¹

2 *Anterior intercostal arteries.* Two anterior intercostal arteries in each of the 6 upper intercostal spaces pass laterally from the internal mammary artery, one courses along the lower border of the rib above, the other along the upper border of the rib below (Fig. 6). The arteries lie at first between the internal intercostal muscles and the pleura, afterward between the external and the internal intercostal muscles. They supply the intercostal muscles, the pectoralis major and as well send nutrient vessels to the ribs. No rami

arising from the intercostal arteries reach the mammmary tissue.

AXILLARY ARTERY

Continued into the upper limb, the subclavian (Fig. 6) becomes the axillary artery (Fig. 5). Within the axillary fossa branches are supplied to pectoral structures. Two of these arteries of the axillary group send branches to the breast (Fig. 4). The first is the lateral thoracic artery, from which a medial branch is derived, descending along the outer margin of the breast, it sends small twigs into the gland, larger branches to the thoracic wall. The second is a muscular trunk which parallels the course of the axillary artery, from it a lateral mammary ramus is given off, which, crossing the superior fourth of the gland, divides into two portions, these anastomose with the mammary rami of the first perforating artery (Figs. 1 and 4, at *a* and *b*).

¹ Ramus *a* (Fig. 1) of the first perforating artery gives only small superficial branches to the breast. Ramus *b* sends several vessels of fair size into the breast penetrating the tissue to depths of from 0.3 centimeter to 1.5 centimeters. Rami *b* and *c* (Fig. 1) of the fourth perforating artery supplying the area around the nipple send strong branches into the mammmary tissue to depths of from 1 millimeter to 2.0 centimeters. However no vessels of dissectable size reach the level of the pectoralis major muscle therefore no demonstrable anastomoses are formed with any twigs derived from the so called medial mammary branches of the anterior intercostal arteries.

² In the fifth intercostal space the branches arise separately from the internal mammary. In the spaces superior thereto they arise by a common trunk. The spaces below the fifth are supplied through the musculophrenic.

5 From these various mammary ram smaller twigs are given off, at a right angle, into the substance of the gland, the more prominent of these are traceable into the mammary tissue to a depth of approximately 2.5 centimeters

6 Both upon the surface of the gland, and within its substance, anastomotic communications between neighboring rami are common

7 None of the so called medial mammary branches of the anterior intercostal arteries pierce the pectoral musculature to reach the overlying mammary gland, they terminate as muscular branches, leaving the deep or thoracic aspect of the gland devoid of arteries of gross proportions

8 Similarly, none of the pectoral rami of axillary derivation pass from the deep level through anterior appendicular muscles to supply the mammary gland

9 No vessels reach the gland from the inferior aspect, they approach the gland only from the medial and the superolateral aspects

SURGICAL CONSIDERATIONS

The female breast is considered by most surgeons to be a highly vascular organ, yet all too frequently little consideration is given to the source of its blood supply, operations are planned from the viewpoint of a ready approach to the lesion, of cosmetic results, and not in relation to the vascular elements of thoracic anatomy

In performing a radical mastectomy, since all the breast as well as the underlying muscles are removed, the operator need give but little consideration to the blood supply of the breast except in so far as complete hemostasis is concerned

The common approach for removal of benign mammary tumors and cysts, especially those which occupy the inferior half of the breast, is through a curved incision made at the junction of the inferior margin of the

breast and the thoracic wall. This approach places the resulting scar out of sight, and therefore has distinct cosmetic value. Furthermore, since the major arteries enter the gland on the superomedial and superolateral aspects, the low incision is least likely to produce troublesome bleeding, in fact the entire mass of mammary tissue may be raised from the underlying pectoral fascia without appreciably disturbing its blood supply. In removing the tumor or cyst, the operator should first follow the line of cleavage between the breast and the pectoral fascia, and then enter the breast itself directly beneath the tumor. If this procedure is followed not only will there be less bleeding, but there will also be minimal trauma to breast tissue. The skin incision may be widened by carrying it laterally and medially if necessary, even, to the transverse line of the nipple. However, in most instances such extension is not required, when carried out it may bring part of the scar into view.

In the removal of tumors from the superior half of the breast, especially when the nature of the tumor is in doubt, the incision should be made radially to the nipple. This again prevents to a marked degree severance of major blood vessels which supply the breast and results in less deformity.

The concentration of blood supply in the superior half of the breast explains the occurrence of severe hemorrhage from ulcerative lesions in that region. Likewise, when incision is made into a deep seated abscess in the superior portion, a large vessel may be severed and severe hemorrhage may occur.

Plastic procedures which are designed to elevate a large pendulous breast can be carried out with comparative safety so far as the blood supply is concerned, since there exists inferiorly an area in which vessels are few in number. For this reason, also, excision of breast tissue should be made from the inferior, not from the superior portion.

ACUTE DIVERTICULITIS OF THE COLON

ARTHUR M SHIPLEY M D F A C S and WALTER H GERWIG Jr M D
Baltimore Maryland

DIVERTICULOSIS is the most common condition of the colon that comes to the attention of the surgeon. In routine examinations from 0.4 per cent to 1 per cent of all patients in whom x ray examinations of the large intestine are made after a barium enema, this condition will be found. In patients over 40 years of age who present themselves for examination because of some abdominal discomfort, diverticulosis will be discovered in from 5 to 10 per cent. In the great majority of these patients the presence of diverticula cause no symptoms and the condition is discovered in a routine examination of the colon.

According to Sommering diverticula of the colon were described in Baillie's *Morbid Anatomy* in 1794. Virchow reported 'chronic adhesive peritonitis' in 1854 and in 1899 Graser associated this observation of Virchow's with diverticulitis. Beer wrote a good description of the condition in 1904 and in 1907 W J Mayo Wilson and Giffin reported 5 cases of diverticulitis treated in the living. Roentgenologists first recognized the condition in 1914. From this time until the present diverticulosis and diverticulitis of the colon have been given increasing attention in medical literature.

The cause of diverticulosis has been much discussed and there are differences of opinion as to what area in the circumference of the bowel is most affected. In the large gut there is a wide variation in the relation of mesentery to bowel. Depending chiefly upon the length of mesentery there is a narrow or wide ribbon of the gut uncovered by peritoneum. Leakage through this area causes extraperitoneal infection.

The longitudinal muscular coat has a peculiar arrangement in the colon. This outer

muscular coat is piled up in three longitudinal bands or tenia. Between these bands the circular muscular coat is thrown into folds or sacculations. These sacculations grow larger and deeper with age. David says "these sacculations are separated by fusiform ridges composed of all layers of the intestine as much mucosal as muscular" and "that these sacculations and ridges retard the passage of faeces."

Close to the mesentery the vessels penetrate a portion of the thickness of the gut and it is believed by some observers that diverticula occur at these points. Kleb was the first to stress this opinion. Much experimental work has been done on the living gut of animals and on the dead human colon to determine the areas of greatest weakness. Experimental data have been presented in support of the belief that the mesenteric border will give way first when the gut is under pressure but surgeons have observed over and over again that in dealing with the distended colon it is the peritoneal coat that gives way first and more over postperitoneal phlegmon due to perforation of the gut between the layers of the peritoneum is a very rare finding in the post mortem examinations of patients dead of intestinal perforation, except in penetrating wounds of the abdomen.

Diverticula are divided into two classes congenital and acquired and many writers speak of them as true and false. In the congenital or true type the wall of the diverticulum contains all of the coats of the intestine. This type plays a relatively unimportant part in diverticulosis and diverticulitis of the large intestine.

In acquired or false diverticula there is a thinning out or absence of the circular muscular coat causing herniation of the submucosa and mucosa through the circular muscle. Most observers agree that acquired diverticula of the colon are found chiefly between the longi-

From the Department of Surgery University of Maryland and the surgical services University Hospital and Baltimore City Hospitals

tudinal bands and not through the region of the mesentery. It would seem, therefore, that atrophy and stretching of the circular muscular coat brought about by fatty degeneration, age, and thinning of the gut wall are the chief etiological factors in acquired diverticula. Constipation and increased pressure within the gut from gaseous distention are associated causes.

All of these changes are associated with advancing years and David has called attention to a frequent finding in the aged of small diverticula between the tenæ and the presence in the sacculations of the colon of small masses of fecal material.

While most patients with diverticulitis are over 40, this condition may occur in the young. Hartwell and Cecil report 2 cases, 7 and 10 years of age respectively, and Ashhurst 1 patient, 7 years of age. One of our patients with an acute diverticulitis of the cecum was 19. Grove and Bell reported in September, 1938, a case of sigmoid diverticulum, which was apparently congenital, in a white female child $4\frac{1}{2}$ years old, in which diverticulitis developed with abscess formation. It was drained and was followed by a fecal fistula for several weeks. This diagnosis was confirmed by x ray and later operation.

In acquired diverticulosis the herniation of the gut wall may take place into the appendices epiploicæ. In most instances the neck of the sac is small, the peritoneal coat is partially covered by tags of fat and unless a careful search is made for diverticula they are apt to be overlooked at operation unless they are filled with fecal material or inflamed.

There are conflicting reports as to the influence of sex on the incidence of this condition. It is generally agreed that both diverticulosis and diverticulitis are more frequent in males, but the relative frequency in the different reports varies between 4 to 1 and 1.25 to 1. While the evidence is conclusive that diverticulosis is more frequent in males, diverticulitis in women is almost as common as in men.

Diverticulitis is less common in the negro. In 7,000 autopsies reported from Cook County Hospital by Kocour he found 127 cases of diverticulosis, an incidence of 1.81 per cent. In 6 of these 127 cases death was due to

diverticulitis. He found the condition less frequent in colored people. In our own experience of 24 operative cases presently to be discussed only 1 was a negro.

The rôle that fat plays in both diverticulosis and diverticulitis is variously estimated. Formerly there was a widespread belief that these conditions are much more frequent in fat, flabby persons, who have eaten too much and exercised too little. This opinion is strongly held by most British writers. The majority of our cases of diverticulitis coming to operation have been in fat people. Careful study of large numbers of patients is modifying this opinion. Brown and Marley in an analysis of 527 patients with diverticula of the colon in whom the weight was noted found 297 were overweight, 180 of normal weight and 50 were thin. They state "a plump patient is more likely to have diverticula of the colon than is a thin patient, but leanness does not make patients immune to this condition."

Diverticula are seen throughout the colon. In all reports the incidence of the condition increases from cecum to sigmoid. Individual writers have found more than half of these lesions in the sigmoid. In Judd and Pollock's series of 118 cases the sigmoid was affected in 75 per cent and Masson reported this portion of the large intestine affected in 81 per cent. We have found a relatively higher incidence in the cecum. Of 24 patients coming to operation 6 the diverticula were in the cecum, in 1 at the hepatic flexure, in 3 in the transverse colon, and in 1 near the splenic flexure. In 11 instances the diverticula were in the ascending and transverse colon and in 13 in the sigmoid. It is interesting to note that although multiple diverticula are reported in a large percentage of patients with diverticulosis, there is little clinical evidence of diverticulitis attacking different sections of the colon in the same patient.

There is considerable anxiety as to the relationship between diverticulitis and carcinoma. It is very often difficult to differentiate between the two by symptoms, examination, or even at the operating table, but the question that is very important is whether or not diverticulitis predisposes to cancer. Apparently not. Rankin reports 4 carcinomas of the

colon in 227 patients with diverticulitis. In Kocour's 127 cases of diverticulosis in 7,000 autopsies there was 1 carcinoma.

On the other hand a chronic, adherent diverticulitis may seriously complicate excision of the colon for carcinoma. David and Gilchrist in May, 1938 reported acute diverticulitis complicating inoperable carcinoma of the sigmoid in 2 patients in whom death was due to perforation of an inflamed diverticulum proximal to the carcinoma. I have a patient in hospital at this writing, a thin man 62 years old whose condition before operation was diagnosed as acute diverticulitis of the transverse colon. When the mass was exposed it was found to be a perforated carcinoma in which the infection had been localized by omentum, gut wall and mesentery.

Most diverticula of the large gut are acquired herniations of the mucosa and submucosa through the circular muscular fibers either between the longitudinal bands or between the lateral tenia and the mesentery. They may occur through the mesenteric border but not very often. If such a diverticulum perforates a postperitoneal phlegmon may develop and infection and suppuration may burrow outside of the peritoneum and point just above the inguinal ligament or the crest of the ilium or the iliopsoas muscle may be invaded and a psoas abscess develop. When diverticula develop on the free surface of the gut they may protrude into an epiploic appendage or be partially covered by fat tags. They are usually relatively small when compared to the size of the colon; the neck of the sac is often constricted and they may or may not contain fecaliths. In most instances these lesions produce no symptoms and the condition is known as diverticulosis.

If one such diverticulum becomes infected by reason of irritation or deficient drainage into the gut the area becomes inflamed. From this beginning the various phases of diverticulitis may develop. Because the neck of the sac is often constricted it may be occluded by exudate or hardened feces.

It is interesting to speculate as to what percentage of individuals with diverticulosis will develop diverticulitis. The percentage has been given as between 12 and 20 per cent.

In the light of more recent observation, an average figure between these two is probably too high. Diverticulitis may be acute, chronic or recurrent. The difference between chronic and recurrent has more to do with symptoms than pathology. Whether the condition is acute or chronic the treatment in the majority of cases should be expectant. Operative treatment is undertaken for the complications of diverticulitis, which are (1) perforation with abscess formation, (2) perforation with diffuse peritonitis, (3) obstruction, and (4) fistula. Operation is sometimes undertaken because of uncertainty as to diagnosis in the acute abdomen especially when the lesion is in the cecum. It may not be possible to differentiate before operation between chronic constricting infection of the bowel because of diverticulitis and carcinoma and a number of patients with acute diverticulitis are operated on who would probably have gotten along satisfactorily without operation, because the diagnosis of diverticulitis could not be made with certainty before operation. More careful attention to history and examination will reduce the number in this latter group but there will be occasions when operation seems the wiser procedure in the acute abdomen even when diverticulitis is suspected.

Brown and Marckley analyzed 1,200 cases of diverticula of the colon in the Mayo Clinic in the decade from 1927 to 1937. They divided them into three groups.

Group 1, 99 cases of diverticulitis treated surgically, either before entering the clinic or at the clinic, 36 of these patients died either following operation or later.

Group 2, 277 cases of diverticulitis in which the treatment was medical, 118 of these patients recovered, 61 continued to have symptoms and 59 were known to have died; however, death in many instances was not caused by diverticulitis.

In Group 3, there were more than 700 of these patients without symptoms of diverticulitis and 220 of these were followed. There was little evidence of trouble in any of this group and 139 of the 220 patients were known to have lived 6 or more years without symptoms of diverticulitis. These patients were treated medically, however.

There are a number of satisfactory classifications of diverticulitis. W. J. Mayo's classification as given by David may be modified somewhat as follows:

1 Self limited diverticulitis. This is the group in which most cases are found and are treated medically in most clinics. They are usually chronic or recurrent and associated with discomfort due chiefly to spasm. They do not always get entirely well under treatment, but are much improved and if properly cared for are not apt to develop surgical complications.

2 Diverticulitis and peridiverticulitis, but without perforation. In one group the process may be acute or chronic and may develop as an adherent mass, often with thickening of the mesentery. The gut is more or less fixed by its adherence to surrounding structures and by shortening of the thickened mesentery. Another group manifests itself as an inflammatory mass, chiefly involving the gut wall, but without serious narrowing of the lumen of the bowel and with little fixation. If the process does not develop beyond this stage these patients are best treated medically, and the great majority will recover without operation.

3 Diverticulitis and peridiverticulitis with perforation. In this group the perforation may develop in a number of ways:

a By localization of infection, because of adhesions and abscess formation. If the abscess is drained before obstruction develops, no other operative treatment may be required and many of these patients recover. Fecal fistula may follow drainage or intestinal obstruction occur later because of angulation of small intestine in the wall of the abscess.

b By perforation into the peritoneal cavity with the development of diffuse peritonitis. There is rarely much actual escape of bowel content, so that feces are not often found in the peritoneal cavity, but the peritonitis is a spreading one and if treatment is not undertaken until the peritonitis is late the prognosis is very bad. In this connection it is well to keep in mind the possible presence in the peritoneal cavity of the anaerobes, especially the *Clostridium welchii*.

c Perforation into the tissues outside of the peritoneal cavity with the possible develop-

ment of postperitoneal phlegmon, psoas abscess or other extraperitoneal collections of pus.

d The formation of a fistulous tract between the colon and some adherent structure. These complications may present some of the most troublesome of the surgical complications of diverticulitis, and may involve the urinary bladder, the ureter, small or large intestine, the appendix, uterus, tube, or ovarian cyst. External fistulas have already been mentioned.

4 Diverticulitis with obstruction. These patients usually present a double syndrome, infection, and obstruction. In most of these cases the symptoms develop relatively slowly and the resemblance to carcinoma is disturbing. Bleeding is not common in diverticulitis, but may be seen in this group. The late Daniel Jones was much concerned with the differential diagnosis in this group and advocated exploration of these patients, because he felt that it was often not possible to exclude cancer by history, examination, or x ray.

5 Diverticulitis, a possible avenue of infection through which lymphatics or blood stream is invaded. David and Gilchrist in May, 1938, reported the histories of 2 patients, both physicians, both gravely ill on admission and with few symptoms and signs that pointed to diverticulitis. At autopsy each had thrombophlebitis of a branch of the portal vein running from an infected diverticulum, with multiple abscesses of the liver.

6 Diverticulitis of the cecum. This condition presents a somewhat different problem from diverticulitis in the rest of the colon. Because appendicitis is such a common disease and because patients with acute appendicitis without complications are operated upon promptly in most clinics, early diverticulitis of the cecum is occasionally found during the course of operation for what was supposed to be acute appendicitis. Here an early self limited diverticulitis may be seen without peridiverticulitis or perforation. Such a condition might very well subside without operation, if the correct diagnosis had been made, but, considering all phases of the condition, the correct diagnosis will be made very rarely. Under these circumstances the proper procedure is to tie off the diverticulum, turn in the wall of the

cecum, over the ligature, if possible, and if this cannot be done, cover the site of the ligature with a pad of fat from the wall of the cecum or a graft from the omentum.

Because diverticulitis is most common in the sigmoid acute diverticulitis often resembles left sided appendicitis and chronic diverticulitis must be differentiated from carcinoma. If attention is paid to the history and care, and thought is given to all methods of examination the symptoms may be evaluated with a fair degree of accuracy but a large number of possibilities must be borne in mind, depending chiefly upon the location of the lesion in the colon and whether or not the diverticulitis is complicated by peridiverticulitis adhesions, abscess peritonitis, pyelophlebitis, postperitoneal infection obstruction or fistulas.

Pain is the most common symptom. This may be intermittent in character and due largely to spasm which is a frequent phenomenon occurring in the colon in this disease. However the pain may be continuous and boring in character. There may be only a feeling of uneasiness in the lower abdomen. More than half of the patients with diverticulitis give a history of constipation and from 10 to 15 per cent have intermittent diarrhea. The stools may be narrowed by spasm or small, hard masses of feces may be seen. Blood in the stools is not common. Pus is rarely seen. Many of these patients give a history of unsatisfactory evacuations, however and if the lesion is low some discomfort is often felt referred vaguely to the sacral region. There is the same uncertainty as to the presence and significance of flatulence.

If the lower sigmoid is involved in women, there may be considerable confusion as to left sided pelvic disease and in both sexes the proximity of the sigmoid to the bladder causes urinary symptoms in about one fourth of the patients. If there is a fistula into the bladder, gas and fecal contamination will be evident in the urine. The fistula may be seen with the cystoscope. Nausea is fairly common, but vomiting is not an outstanding symptom. Even in the obstructive cases distention of the proximal colon may allow the upper intestinal tract to drain itself into the large intestine for a number of days without resort to vomiting.

Tenderness is a helpful symptom when present, and tumefaction was reported by Rankin and Brown in 31 per cent of the 227 cases of diverticulitis reported by them in 1930. They also report that in the 48 patients in this series operated upon the hemoglobin was below 70 in about one fourth of the cases.

If the patient's condition warrants a barium enema, roentgenoscopic examination is the most satisfactory and conclusive method of diagnosis. Care should be taken not to load up the bowel above the lesion with a barium meal.

Proctoscopic examination is helpful in some cases, diagnostic in a few and negative very often. It is very helpful in differentiating between carcinoma and diverticulitis, if the lesion is within reach of the sigmoidoscope. In a few instances the openings of the diverticula may be seen. More often the sigmoidoscope will discover fixation of the sigmoid and edema and reddening of the mucosa without ulceration in low sigmoid involvement. This finding is most helpful in differentiating between possible diverticulosis and carcinoma. It may give information as to the length of healthy mucous membrane below the lesion.

The treatment of diverticulitis is operative only when complications exist or the diagnosis cannot be made with reasonable certainty in the acute abdomen or the question of carcinoma cannot be otherwise settled in chronic colonic disease.

The need for operative procedures has already been given under classification. The surgeon has a considerable number of operative attacks at his disposal when he is dealing with acute or chronic diverticulitis requiring operative relief. Early diverticulitis of the cecum has been discussed under classification. The most common complication requiring surgery is peridiverticulitis with localized abscess. Here drainage of the abscess with a minimum handling of the intra-abdominal structures is indicated. If there are no obstructive symptoms simple drainage is all that is necessary. It is unwise to attempt to deal with the infected diverticulum. There is considerable recent literature dealing with the bacterial flora of the appendix and large intestine and the different micro organisms found

in peritonitis. When perforation occurs the issue is determined largely by the kind, number, and virulence of the organisms and the resistance of the host.

"There are fairly uniform reports as to the aerobes, *Escherichia coli* (*Bacillus coli*) and various strains of streptococci being found in a high percentage of cases. Other aerobes are found as well, the staphylococcus, a gram positive bacillus, and others. Occasionally *Hemophilus influenzae* (*Bacillus influenzae*) is present.

"Altemeier in 100 cases of perforated appendicitis recovered 16 different aerobes from the purulent material. Bower and his associates, reporting the flora in 55 patients, are in agreement so far as the aerobes are concerned.

There are a number of reports as to the presence of anaerobes. Altemeier and Bower et al report as to the presence of *Clostridium welchii* (*Bacillus terogenes capsulatus*, *Bacillus perfringens*, *Bacillus wellchii*), and other observers are in accord with them in reporting a high incidence of clostridia, especially *Clostridium welchii*. Another clostridium occasionally present is *Clostridium oedematis maligni* (*Vibrio septique*, *Clostridium septique*, *bacillus of malignant edema*). Altemeier reports for the first time the presence of *Bacillus melanogenicum* in 92 per cent of patients examined. Bower et al also report that 69 per cent of patients suffering from or recovering from spreading peritonitis had demonstrable and significant amounts of circulating antitoxin to *Clostridium welchii*. Jennings found *Clostridium welchii* in the lumen of the appendix in 90 of his cases.

"Altogether, these bacteriological studies of pus in peritonitis, complicating a perforated large intestine lesion are very disturbing to the surgeon. Most operators formerly believed that they were dealing with *Bacillus coli*, different strains of streptococci and an occasional staphylococcus, and many suspected that *Hemophilus influenzae* played an unknown role in peritonitis and appendicitis.

"But the knowledge that anaerobes are commonly present adds another factor that demands consideration. Under certain conditions, parasites attacking the tissues of the body prepare a pabulum in which the sapro-

phytes flourish, and in addition to this the question of symbiosis demands immediate consideration. This is pertinent when it is recalled that progressive gangrenous ulceration of the abdominal wall is found in association with drainage tracts following perforated gut, especially when it is remembered that this is a symbiotic infection between specific strains of the staphylococcus and streptococcus.

"Meleney has stressed the possibility of symbiosis as an explanation of the varying behavior of suppurative peritonitis. "In any specific prophylactic or active treatment for peritonitis one must take into account the symbiosis of the commonest organisms found in the peritoneal exudate, namely *Escherichia coli*, the green streptococcus and *Clostridium welchii*."

In the operative treatment of peridiverticulitis with localized abscess there will be found, occasionally, at operation very considerable thickening of the entire circumference of the gut. Even if carcinoma is suspected, resection is unwise in the presence of localized suppurative peritonitis. The patient may not have complete obstruction, but the surgeon is often uncertain as to whether the gut will become shut off or not. Under these circumstances colostomy at some distance proximal to the lesion will serve a double purpose, it will decompress the distended and partially obstructed gut and it will divert the fecal stream away from the area of infection. In peridiverticulitis with abscess formation, gentle operative manipulation confined to the immediate region of the abscess, adequate drainage, and colostomy offer an adequate operative plan, provided the patient is a reasonably good operative risk.

In 3 of the patients on whom I have operated for peridiverticulitis and thickening of the walls of the colon, there were no adhesions about the peridiverticulitis. The abscess cavity was walled off by gut wall, mesentery, and epiploic appendages, and the mesentery of the sigmoid or transverse colon was long enough to permit exteriorization of the section of gut involved. This area of intestine was delivered through the peritoneum and the parietal peritoneum was sutured lightly to the colon, the inflamed gut was left in the abdom-

inal wall outside the peritoneum and covered with thin rubber tissue to limit adhesions to the abdominal wall. Twenty four hours later the abscess was drained. In none of these 3 cases was it necessary to do a colostomy, although it could have been easily done and after the lapse of several weeks, when the infection had cleared up, the gut was dropped back into the peritoneal cavity.

Cecostomy is not a very satisfactory way to divert the fecal stream in the colon. In acute or chronic obstruction the gut may be decompressed and the gaseous content of the bowel will escape, but there is a tendency to the accumulation of hardened feces between the cecostomy and the site of obstruction. For this reason colostomy is the more satisfactory procedure and if the opening in the colon is not too large, its closure spontaneously or by operation is very nearly as satisfactory as is the cecostomy opening.

If the diverticulitis is an obstructing one and suppuration is not present, resection may be the method of choice, especially if the proximal gut is not sufficiently distended with gas and filled with fecal matter as to require decompression. In my experience, however, resection without previous decompression and careful preparation of the patient for operation is a dangerous operation unless the obstructed section of gut can be operated on after the method of Mikulicz.

In addition to the 24 cases in this report operated on in my service, I have seen in consultation 3 patients on whom resection of the sigmoid had been done in the midst of obstruction and infection, in the belief that the lesion was carcinoma. In all 3 cases no proximal cecostomy had been done for decompression and these patients were dying of diffuse peritonitis when seen. In each instance examination of the specimen after its removal had convinced the surgeon that the changes in the gut wall were due to diverticulitis and not to carcinoma.

One of the earlier cases presented an interesting finding. The patient had been having symptoms of lower abdominal discomfort with unsatisfactory bowel evacuations. The x ray examination showed no filling defect indicative of cancer and failed to show diverticulosis.

The sigmoidoscope disclosed nothing. There were no urinary symptoms. The patient was between 40 and 50 years of age and not fat. It was thought he had recurrent appendicitis, but because his symptoms were not clear cut a right paramedian approach was used. When the lower abdominal cavity was explored the sigmoid and cecum were found close to each other, but not adherent. On closer inspection it was seen that the tip of the appendix was adherent to an inflamed diverticulum of the sigmoid. The appendix was first freed from the cecum, its base was turned in, the diverticulum of the sigmoid was ligated close to the gut wall and the area was covered with tags of fat. When the specimen was examined a fistulous tract ran from the appendix into the diverticulum. The condition was a chronic one. There was no suppuration and very little peridiverticulitis. This patient's convalescence was uneventful.

In another case in this group a mistaken diagnosis of early carcinoma of the sigmoid was made. There was a small area of gut wall irregularity seen in the roentgenogram on the mesial side of the sigmoid and this patient gave a history of spasm, with small amounts of blood seen occasionally in the stool. In the x ray film the lesion was not an annular one and there were no symptoms of obstruction.

At operation a chronic diverticulitis was found adherent to one loop of small intestine. Inflammation was not active. The diverticulum was well away from the mesentery. The adhesion was freed, the diverticulum was ligated, and the base was covered over with fat tags. Because of induration no attempt was made to turn in the wall of the sigmoid. These were the only 2 cases in which any direct attack was made on the inflamed diverticulum, except in 4 patients who had early, acute diverticulitis of the cecum.

In one of these patients a clinical and x ray diagnosis of carcinoma of the colon just proximal to the splenic flexure was made. This patient had partial obstruction. At operation a well localized diverticulitis was seen with marked edema and thickening of the colon. Because there was no general peritoneal involvement and obstruction was present, ileo-sigmoidostomy was done and the region of the

diverticulitis was drained by means of a stab wound through the left lateral abdominal wall just ventral to the upper margin of the lateral gutter. Although this procedure is open to criticism, the patient made a good recovery.

Attention has been called to the relative greater incidence of biliary duct diseases in patients with chronic or recurrent diverticulitis. This relationship seems clear enough.

In a patient who was being treated expectantly and who had a rather more acute attack than usual of recurrent diverticulitis, there developed acute right upper abdominal pain with the formation of a tender mass in the region of the gall bladder. This patient had multiple diverticula, but the area of diverticulitis was in the lower sigmoid. We diagnosed the right upper abdominal mishap acute cholecystitis and pericholecystitis, but were not unmindful that he might have a perforated diverticulitis in the region of the hepatic flexure. The condition increased in severity and at operation an acute, thrombotic gall bladder was found and removed.

The question of drainage in all operations within the peritoneal cavity for conditions due to infection is a matter of controversy. In all these 24 cases except the 4 cases of early diverticulitis in the cecum drainage was instituted. Three of these 24 patients died. One was an obese white woman, 73 years old, who entered the hospital with lower abdominal pain. She was a diabetic and quite ill. It was believed she had diverticulitis and she was treated expectantly. She developed pneumonia on the ninth hospital day. On the twelfth day a lower left abdominal mass appeared and increased rapidly in size. This area was operated on under spinal anesthesia and a peridiverticulitis and pelvic abscess was found and drained. She died on the fourteenth day. Whether this patient's chance of living might have been improved by colostomy soon after admission is one of the things about which surgeons are harassed, no matter what advice they give or what action they take.

The second death was in a thin man, 44 years of age, whose illness began 5 days before admission with what was diagnosed as colitis. His outstanding symptoms at onset were pain and diarrhea. Forty eight hours before ad-

mission he became worse, with diffuse abdominal pain, distention, nausea, and vomiting. On admission he presented the picture of late, diffuse peritonitis and at operation a very large quantity of foul smelling pus was found, widely diffused throughout the peritoneal cavity. He had a perforated diverticulitis of the sigmoid with no walling off. His pelvic, right subhepatic and left subphrenic regions were drained, because pus had pooled in these areas. He improved somewhat for 2 days, but died of late diffuse peritonitis on the sixth postoperative day.

The third death was that of a very obese woman, 56 years old, who was admitted June 5, 1938, with diverticulitis and peridiverticulitis of the left side of the transverse colon. There was a large mass in this region and at operation a large abscess was found and drained through a left transverse incision. She made a slow convalescence at first, but improved later and went home. Her abdominal wound healed and she seemed in good condition. Quite suddenly, 4 months later, she became ill with abdominal discomfort. There was a chill and on admission the following morning there was a tender mass in the same region, but there were signs of diffuse peritonitis. The old incision was opened and a large abscess was found and drained. A low right McBurney incision disclosed a diffuse peritonitis with considerable free gas in the peritoneal cavity. She died of diffuse peritonitis. She had no symptoms of obstruction during her first attack, but it is possible that cecostomy or colostomy done at the time of the first operation might have promoted healing of the diverticulitis and prevented the second attack.

We have had no experience with fistulas in our cases, except the one patient with appendicodiverticular fistula. This group of patients, however, presents the most difficult operative problem in the surgical complications of diverticulitis. As a preliminary to operative attack on the fistulous tract, colostomy well away from the fistula is a wise procedure and in a number of instances will be followed by spontaneous healing of the fistula. When the fistula persists after colostomy operation is cleaner, safer, and the chance of successful closure of

istula is better, if the bowel is decompressed and the fecal stream diverted

CONCLUSIONS

1 Diverticulosis of the colon is present in from one half to one per cent of all patients examined for this condition

2 Diverticulitis is rare in patients under 40 years of age but in patients with lower abdominal symptoms above 40 years of age diverticulosis will be found in from 5 to 10 per cent of those subjected to examination by barium enema and roentgenogram

3 Patients older than 40 years with diverticulosis may develop diverticulitis in a disturbing number of instances unless they take pains with their diet and regulate their bowel evacuation

4 Most patients with diverticulitis will not develop an operative complication and are best treated medically

5 The surgical complications are peridiverticulitis with perforation and abscess formation diffuse peritonitis obstruction, and fistula

6 Diverticulitis may be acute, recurrent or chronic and may be found in any section of the colon and may involve any area in the circumference of the gut

7 Because of the wide possibilities enumerated under 5 and 6 no single operative procedure will be found adequate for all cases

8 In the acute cases however, drainage and colostomy are often indicated

BIBLIOGRAPHY

- 1 ABEL R Case of sigmoid diverticulitis simulating malignancy *Med Rec* 1914 86 100
- 2 ABEL J Diagnosis and treatment of diverticulitis and diverticulosis *Surg Gynec & Obst* 1935 60 3-39
- 3 ALTENBACH W A The bacterial flora of acute perforated appendix with peritonitis *Ann Surg* 1938 10 517-528
- 4 ASHLEST Quoted by Hartwell and Cecil
- 5 BARKING J Diverticulitis of colon *Birmingham M Rev* 1936 11 12-18
- 6 BEER EDWIN Some pathological and clinical aspects of acquired (false) diverticula of the intestine *Am J M Sc* 1904 28 135
- 7 BOWER J O MENDEL H A and PARSON N F The demonstration of antitoxin for the toxin of *Clostridium welchii* in the blood serum of patients and dogs that have recovered from spreading peritonitis complicating acute perforative appendicitis *J Immunol* 1938 34 185-193
- 8 BROWN P W and MARCLEY D M Prognosis of diverticulitis and diverticulosis of colon *J Am M Ass* 1937 109 1328-1333
- 9 BROWN P W and LOGAN A H Medical treatment of diverticulitis of sigmoid *Proc Staff Meet, Mayo Clin* 1936 21 37-40
- 10 CABOT Case 27422 Diverticulitis of colon *N England J Med* 1936 215 729-731
- 11 Idem Case 29052 Diverticulitis of colon with perforation pulmonary embolus and infarction *N England J Med* 1933 208 260-263
- 12 DAVIS V C Diverticulosis and diverticulitis with particular reference to development of diverticulitis of colon *Surg Gynec & Obst* 1913 56 375-381
- 13 DAVIS V C and GILCHRIST R K Complicating effects of diverticulitis of colon upon abdominal surgery and especially upon surgery of the large bowel *Ann Surg* 1938 10 801-803
- 14 EDWARDS H C Diverticulitis Clinical review *Brit M J* 1934 1 975
- 15 Idem Diverticula of colon and vermiform appendix (Hunterian Lecture) *Lancet* 1934 1 221-227
- 16 FRANKLIN W W Diverticulitis of colon *J Iowa State M Soc* 1938 26 251-257
- 17 FRIEDENWALD J and FELDMAN M Diverticulosis and diverticulitis *Rev Gastroenterol* 1935 2 97-110
- 18 GRASER E Ueber multiple Divertikel in der Flexura sigmoidea *Verhandl d deutsch path Gesellsch* 1899 28 254 Das folche Darmdivertikel *Arch f klin Chir* 1899 59 638
- 19 GROVE LOY and BELL KENNETH R Acute diverticulitis of the colon with complications *J Med As Georgia* 1938 p 337
- 20 HARTWELL J A and CECIL R L Intestinal diverticuli a pathological and clinical study *Am J M Sc* 1910 120 174
- 21 HESTON H R Diverticulitis of colon in women *Arch Surg* 1931 26 1111-1117
- 22 JENNINGS J P The rôle of *Bacillus welchii* in gangrenous appendicitis *New York M J* 1923 117 682-685
- 23 JONES D F Diverticulitis of the colon relation to carcinoma *New England J Med* 1930 203 439
- 24 JONES T E Surgical treatment of diverticulitis *Cleveland Clin Quart* 1937 4 207-211
- 25 JUD E S and PHILLIPS J R Diverticulitis *Surg Clin N America* 1934 14 542-548
- 26 JUD E S and POLLOCK I W Diverticulitis of the colon *Ann Surg* 1921 80 425
- 27 KLEBS Pathological anatomy 1896 p 271
- 28 KOCOKER E J Diverticulitis of colon incidence in 7000 consecutive autopsies with reference to its complications *Am J Surg* 1937 37 433-436
- 29 LOCKHART MUMFERY J P Adhesions of the mesentery associated with abnormalities of the mesentery causing constipation *Lancet* 1919 196 754
- 30 Idem Etiology of diverticulitis *Lancet* 1930 1 231
- 31 LOCKHART MUMFERY J P and HOBSON G Diverticula of colon sequelae *Brit M J* 1931 1 525
- 32 MARSHALL C J Treatment of diverticulitis of colon *Proc Roy Soc Med* 1936 29 339-342
- 33 MASSOW J C Diverticulitis of the large bowel *Canadian M J* 1921 21 206
- 34 MAYO W J Diverticulitis of the large intestine *J Am M Ass* 1917 69 781
- 35 Idem Diverticulitis of the sigmoid *Brit M J* 1929 2 574-576
- 36 Idem Diverticula of the sigmoid *Ann Surg* 1930 92 739

- 37 MAYO W J WILSON L B, and GIFFIN, H Z Acquired diverticulitis of the large intestine Surg, Gynec & Obst 1907 5 8
- 38 MELENEY F L OLPP J HARVEY H D, and JERN H Z Peritonitis synergism of bacteria commonly found in peritoneal exudates Arch Surg 1932, 25 709-721
- 39 NIXON E A Diverticulitis of colon Northwest Med, 1938 37 97-100
- 40 O'BENOUR S W Gangrenous diverticulum associated with suppurative appendicitis (case) Ohio State M J 1938 34 175-176
- 41 OCHSNER H and BARGEN J A Diverticulosis of the large intestine Ann Int Med 1935 9 282
- 42 RANKIN F W and GRINES A E Surgical treatment of diverticulitis South Surgeon 1938 7 1-15
- 43 RANKIN F W and BROWN P W Diverticulitis of the colon Surg Gynec & Obst 1930 1 836-847
- 44 SHIPLEY A M The treatment of peritonitis complicating appendicitis New England J Med 1938, 219 333-338
- 45 SOMMERING Referred to by Fisher M H False diverticula of intestine J Exper Med, 1900, 5 333
- 46 SPRIGGS E I and MARXER O A Intestinal diverticula Brit M J 1926 1 130
- 47 STETTIN, DEW and ABELOFF A J Clinical picture and therapy of diverticulitis of colon J Mt Sinai Hosp 1938 4 781-791
- 48 VIRCHOW R Historisches kritisches und positives zur Lehre der Unterleibsaffektionen Arch f path Anat 1853 5 281
- 49 VISCONTI, J A Diverticulitis of ascending colon simulating acute appendicitis Am J Surg 1936 32 376
- 50 WEIBLE, R E Diverticulitis of colon Minnesota Med, 1937, 20 21-28
- 51 Idem Acute diverticulitis of sigmoid Am J Surg 1935 28 142-144
- 52 WETHERELL, F S Diagnosis and management of diverticulosis and diverticulitis of pelvic colon in women Am J Obst & Gynec 1938 35 417-425
- 53 WILKINSON S A Diverticulosis and diverticulitis of the colon New England J M 1933 209 197
- 54 WILLARD J H and BOCKUS H L Clinical and therapeutic status of cases of colonic diverticulosis seen in office practice Am J Dis of Digest etc 1936 3 580-585
- 55 WILSON, L B Diverticula of the lower bowel their development and relationship to carcinoma Ann Surg 1911 53 223

EVALUATION OF NECK DISSECTION IN CARCINOMA OF THE LIP

GRANTLEY W TAYLOR MD FACS, and IRAT NATHANSON MS, MD
Boston Massachusetts

THE present study was undertaken in the hope of establishing data on which can be based decisions and conclusions in regard to management of the cervical lymph nodes in carcinoma of the lip. We have studied our material from the viewpoint of the characteristics of the primary lesion and of the cervical lymph nodes as bearing on the likelihood of the presence of cervical metastases and on the curability of such metastases if present. We have also analyzed the time of appearance of positive nodes to determine the optimum follow up observation period and the location of recurrences to evaluate the adequacy and extent of the neck dissection as carried out.

In recent years there has been considerable discussion in the literature on these problems. Questionnaires analyzed by the Cancer Commission of the California Medical Association (9) and by the Cleveland City Hospital Tumor Clinic (3) emphasized the wide differences of opinion which exist. While these differences of opinion and the reasons offered in justification of the opinions are clearly stated by Pfeuffer there has been apparently a lack of specific information on which to base definite conclusions.

The material studied includes cases of carcinoma of the lip treated at the Collis P Huntington Memorial and Massachusetts General Hospitals during the years 1922 to 1936 inclusive and at the Pondville Hospital during the years 1917 to 1936. Since certain of the patients have been treated at more than one of these hospitals care has been taken to eliminate duplication of cases. In the main treatment at these hospitals has been surgical and much of the material available for the study of the effect of radiation is vitiated by

lack of pathological confirmation of the diagnosis. Many of our cases have been included in previously reported end result studies from the respective hospitals (6, 12, 13). Our present study is not primarily an end result study. Untraced cases have been omitted as inconclusive, and many of the tables represent only that part of the total group in which information on the particular point was available. Cures in general have been followed for at least 3 years after the last treatment was given, although in some of the more recent cases this has not been possible.

Our method of treatment has consisted in surgical excision of the lesion of the lip in most instances, although in recent years there has been a considerable group treated by radiation. The neck dissection has consisted in a block dissection of the suprahyoid region essentially as described by Kennedy, Fischel, and others. In many instances a slightly larger area has been included in the dissection roughly as described by Blair, Quick and Martin (8), including the upper part of the jugular chain of lymphatics to a point below the carotid bifurcation. This operation has usually been unilateral unless the primary lesion involved or extended to the midline or unless there appeared to be bilateral node involvement. Although most of the dissections were carried out at the same time the lip operation was done we agree with Wangenstein and Fischel that the dissection of the nodes should be deferred until the lip wound has healed. This permits reappraisal of the cervical lymph nodes after subsidence of the inflammation which is usually present in the nodes secondary to sepsis in the lip carcinoma. We have been impressed by the improved wound healing and elimination of drainage and wound sepsis in cases in which neck dissection is deferred. In a few instances very radical atypical operations have been carried

From the Collis P Huntington Memorial Hospital, Cancer Commission of Harvard University, the Pondville Hospital, Massachusetts Department of Public Health and the Massachusetts General Hospital.

TABLE I—SIZE OF LIP LESION IN RELATION TO NODE METASTASES

Size	Total cases	Per cent with positive nodes	Per cent cures in positive node cases
Less than 1 cm	93	7.5	57
1 to 2 cm	328	13	55
to 3 cm	136	37	57
3 cm and over	59	24	43
Total	616	19	51

out in advanced and apparently inoperable cases in the hope of effecting a cure, and this has been successful in some cases. We have not concerned ourselves with these exceptional cases in this study. We have accepted contraindications for neck dissection similar to those described by Quick, C. L. Martin, Leland, and others, namely fixation or extracapsular extension of metastases, or multiplicity of nodes, or clinical evidence of extensive bilateral involvement.

Size of primary lesion. Knowledge of size of the primary lesion is available in 616 cases, of which 411 patients were submitted to neck dissection. Two hundred and five patients received no treatment to the neck and were cured by excision of the local lesion except in 5 patients in whom recurrence took place in the lip. These 205 cases are included in the group without cervical metastasis in Table I.

It is evident from the table that cervical node involvement increases progressively with increased size of the primary lesion. The apparent falling off in the percentage of cervical node involvement in the lesions over 3 centimeters in extent is due to the fact that only operable cases are included in the table. Obviously very large local lesions associated with involved lymph nodes are often considered to be inoperable. Such cases are not included in the table. Hence the very large lesions included in the operable group include a higher percentage of cases of very low grade malignancy. It is also evident from the table that patients with positive nodes in which the primary lesion is large are less likely to be cured even if given the benefit of neck dissection. Nineteen patients ultimately showed recurrent disease in the lip, and in 9 instances this was associated with recurrence in the neck as well.

TABLE II—SIZE OF LIP LESION IN RELATION TO NODE METASTASES—CASES WITH NECK DISSECTION

Size	Nodes not palpable		Nodes Palpable	
	Total cases	Per cent with positive nodes	Total cases	Per cent with positive nodes
Under 1 cm	19	21	20	15
1 to 2 cm	109	15	92	30
2 to 3 cm	36	22	81	53
Over 3 cm	22	18	32	30

TABLE III—DURATION OF LIP LESION IN RELATION TO NODE METASTASES

Duration	Total cases	Per cent positive nodes
Under 1 year	352	14.5
1 to 2 years	148	21.5
2 to 3 years	63	33.3
Over 3 years	60	25.0

If attention is restricted to patients with palpable nodes who were submitted to neck dissection, the increased incidence of metastatic involvement with the larger lesions is even more emphasized. In the group of patients without palpable nodes, who were submitted to operation, the incidence of microscopic involvement is fairly constant irrespective of the size of the primary lesion (Table II).

It is evident from the table that positive nodes are clinically not discernible in about a fifth of all the cases which are submitted to neck dissection. The discrepancy between this table and Table VI below is due to the fact that Table II includes a large number of delayed and secondary cases.

Duration of primary lesion. Knowledge as to the duration of the primary lesion is available in 416 cases in which neck dissection was carried out, and in 207 cases in which no treatment was administered to the neck. Of the latter group, which is included in Table III as patients without cervical node involvement, 5 patients later died with recurrence of the primary lesion of the lip.

It is evident that the group with duration greater than 3 years has already undergone a selection, in that cases of long duration which are far advanced are not considered operable. However, the general tendency is clearly shown in the table, namely that the likelihood of cervical node metastasis is greatly increased, the longer the primary lesion is present before treatment.

TABLE IV—GRADE OF MALIGNANCY IN RELATION TO NODE METASTASES

	Total cases	Per cent with positive nodes	Per cent cured in positive node cases
Low grade	348	6	36
Medium grade	181	30	61
High grade	50	52	57

Grade of malignancy of the primary lesion
Grading¹ of the primary lesion was carried out in 579 cases according to the general histological criteria described by Broders. We have classified our cases into 3 groups according to the degree of malignancy shown in the sections. In 360 cases neck dissection was carried out while in 219 cases treatment was restricted to the lip. The results are shown in Table IV.

It is evident that the likelihood of cervical node involvement increases greatly with the higher grade lesions and that it is very slight in the lower grade lesions. The last column in Table IV shows strikingly that cervical node involvement is just as curable when the primary lesion is of high grade malignancy as it is with low grade lesions.

Location of the primary lesion It has been suggested that carcinoma of the upper lip is less likely to involve cervical nodes than is carcinoma of the lower lip. There were 18 instances of carcinoma of the upper lip in this series and in 9 of these cervical node metastases occurred. This is in contrast with the general incidence of node involvement of about 20 per cent for the whole series.

It is probable that when these upper lip cases are further studied as to grade, size, duration etc. it will be found that their behavior in regard to metastases corresponds to that of carcinoma of the lip in general. Location and extent of the lip lesion also has important bearing on the location of the nodes involved in metastases and on the decision for or against bilateral dissection.

Age of the patient It has been stated that carcinoma of the lip is a more malignant condition in younger patients. Data in regard to the age of the patient at onset of the disease are available in 514 cases in which neck dissection was carried out (Table V).

TABLE V—AGE OF PATIENT IN RELATION TO NODE METASTASES

Age in years	Total cases	Per cent with positive nodes	Per cent cured in positive node cases
30 to 40	22	27	50
40 to 50	76	21	50
50 to 60	155	34	34
60 to 70	185	38	50
70 to 80	72	48	43
80+	4	75	67

It is evident that in this series of cases there is a consistent upward trend in relation of incidence of metastases to the age of the patient (15). The older age groups show a higher incidence of lymph node involvement than do the younger group. This is probably explainable on the basis of increased delay before treatment in the older patients.

Effect of recurrence of primary lesions In a series of 276 cases in which the primary lip lesion was cured at the first attempt, nodes were found involved in 80 cases (29 per cent). In a series of 97 cases in which the lip lesion recurred after the first attempt at cure and which were later subjected to a second attempt at local cure along with neck dissection, the nodes were found involved in metastasis in 62 cases (64 per cent). Forty patients in this group were never cured of the local lesion. In cases with recurrence in the lip in which patients were finally cured, 45 patients were cured after one recurrence. In these 12 (27 per cent) proved to have nodes involved at the time of neck dissection. In a group ultimately cured after multiple recurrences, there were 9 patients of whom 5 (55 per cent) had cervical node metastases.

These data clearly indicate the increased incidence of cervical node metastasis when the local lip lesion is not cured on the first attempt. While the increased manipulations incident to repeated attempts at cure of the primary lesion may partly account for this increase in the incidence of metastases it is reasonable to emphasize that recurrence and repeated recurrence implies a greater total duration of the primary focus of disease already shown to be of significance. Recurrence also implies greater invasiveness and higher grades of malignancy.

Size of the lymph nodes In 410 primary cases the lymph nodes were described as not

¹W. A. E. de la Roche, D. S. H. W. and Dr. Benjamin Castleman for reviewing the grading of the lesions.

TABLE VI — METASTASIS IN IMPALPABLE LYMPH NODES

	Total cases	Percent with positive nodes	Percent cures in positive node cases
No primary treatment to neck	247	8.2	15
Prophylactic neck dissection	153	10.0	57

palpable on the occasion of the first examination. Many of the examinations were undoubtedly careless or incomplete, but at any rate it may be assumed that nodes were at least inconspicuous in these cases. Two hundred forty seven of these patients were treated by excision of the primary lesion alone, without any primary treatment to the neck. Later, neck dissection was carried out in 25 cases because of the development of palpable lymph nodes, and the nodes proved to be positive in 20 of these and were cured in 3 instances.

One hundred fifty three patients were treated by excision of the local lesion and primary neck dissection. Of these, 15 patients presented metastatic involvement of the cervical lymph nodes, which was cured in 9 instances. One patient who received no treatment to the neck subsequently developed fatal involvement of the cervical lymph nodes.

Results are shown in Table VI.

It is evident that in primary cases in which the nodes are not palpable there will be present microscopic involvement of the nodes in slightly less than 10 per cent of cases. In other words clinical appraisal of the absence of node involvement is subject to about a 10 per cent error. The curability of nodes is vastly lessened if the neck dissection is deferred until the involvement becomes clinically obvious. This is undoubtedly accounted for by the inclusion in the deferred group of a considerable number of neglected cases.

When nodes are palpable there seems to be a definite relationship between the size of the nodes and the likelihood of metastatic involvement. (6) Consistency of the nodes is a less reliable guide, and less measurable, no attempt has been made to analyze our cases from the viewpoint of the node's hardness.

Knowledge is available as to the size of the palpable lymph nodes in 101 primary cases in which neck dissection was carried out.

TABLE VII — SIZE OF PALPABLE NODES IN RELATION TO METASTATIC INVOLVEMENT — PRIMARY NECK DISSECTION

Size of node	Total cases	Percent with positive nodes	Percent cures in positive node cases
Not palpable	153	10	57
Under 1 cm	36	9	40
1 to 2 cm	37	60	54
Over 2 cm	8	75	50

Table VII shows the strikingly increased likelihood of cervical metastasis in the larger nodes. The incidence of involvement in nodes less than 1 centimeter in diameter is practically identical with the incidence in those cases in which no nodes were palpable.

The figures for cure here merit some comment. In the group of 5 patients with small nodes involved in metastasis, 2 patients died of recurrence or persistence of their primary lip disease. The rather high curability in the larger node group does not reflect a true state of affairs. Obviously, the larger nodes are more likely to become fixed or to be considered inoperable for other reasons, hence the patients who are included in the groups of larger nodes and in whom operation was done are in a sense selected. The figures do show, however, that if nodes appear to be operable, there is a reasonable chance of cure even if they are of fairly good size, provided that they are movable.

Further data as to the character and size of nodes in relation to their likelihood of harboring metastasis and their curability under these circumstances are offered by a study of the delayed neck dissection group and the group of secondary cases.

In the primary group with delayed neck dissection, in many instances patients were lost track of, and reappeared at the clinic only after nodes had progressed to the point of unmistakable metastatic involvement. When all these cases were included in a consideration of size of the nodes in relation to presence of metastasis, it is even more evident that the larger the node the more likely it is to present metastatic involvement (Table VIII).

Delayed neck dissection. Data are available in 61 cases in which neck dissection was deferred until the development of lymph node involvement had apparently occurred. While

TABLE VIII—SIZE OF PALPABLE NODES IN RELATION TO METASTATIC INVOLVEMENT—ALL NECK DISSECTIONS

Size of node	Total	Per cent with positive nodes	Per cent cured in positive node cases
Less than 1 cm	63	9.5	33
1 to 2 cm	57	67	53
Over 2 cm	23	91	43

many of these dissections were carried out promptly enough to justify designating the management as watchful waiting, others were the result of neglect or insufficient follow up. We have assumed that a delay of 6 months or more involved an element of neglect, in contrast with neck dissections carried out within 6 months of treatment of the lip lesion. Findings in these cases are shown in Table IX.

It is apparent that clinical appraisal of the presence of lymph node metastasis is frequently erroneous even in these deferred cases. It is also apparent that when a policy of adequate surveillance can be followed the results of deferred dissections compare favorably with those obtainable by primary dissection. On the other hand the opportunity for cure is definitely jeopardized by neglect and in adequate follow up.

Distribution of nodes Although our pathological material lacks data on which to base a sound statistical conclusion it is our impression that if a considerable number of nodes prove to be involved the prognosis is very poor.

Analysis was made of the cases with palpable nodes to determine the relative incidence of actual metastatic involvement when nodes were confined to one side of the neck as contrasted with bilateral nodes.

Unilateral nodes were palpable and dealt with by unilateral neck dissection in 101 cases. In 43 of these there was metastatic involvement, and of these 24 or 56 per cent, were cured by operation. Bilateral palpable nodes were dealt with by bilateral suprahyoid dissection in 58 instances and in 38 58 per cent metastatic involvement proved to be present. The actual metastatic involvement was unilateral in 12 cases of which 6, 50 per cent were cured. In contrast bilateral metastases were found in 26 cases of which only 5 19 per cent, were cured.

TABLE IX—NODE METASTASES IN DELAYED NECK DISSECTIONS

Delay	Total	Per cent with positive nodes	Per cent cured in positive node cases
Less than 6 mos	9	90	63
6 mos and over	38	73	34

Thus it may be concluded that unilateral node involvement is curable in about half of the cases subjected to dissection, as opposed to one fifth of the cases with bilateral involvement. These figures are based on delayed and secondary cases as well as primary cases. Probably the poorer results in the bilateral cases are explainable on the basis of multiple node involvement and hence the greater extent of the disease.

Fixation of nodes Although fixation and extracapsular extension of nodes, or the involvement of nodes outside the area of usual suprahyoid dissection are commonly held to classify the case as inoperable, in certain instances radical surgery has been resorted to in otherwise favorable cases. This has been true notably in cases in which a few submaxillary nodes have been more or less fixed to the mandible or have involved muscles in the submaxillary area. In some of these, periosteal stripping or even jaw resection or extensive muscular resection has been carried out. While in general this group of patients is incurable and while extensive radical operations involve the hazard of an increased operative mortality, in certain cases cures have been accomplished by these methods. Such cases must be individually evaluated and do not permit statistical analysis.

We conclude that if nodes are clinically malignant and bilateral, the cases are probably too far advanced to warrant much hope of cure. Prognosis is probably better if the two sides are involved consecutively rather than simultaneously.

Location of recurrences In the analysis of the cases which were not cured we were struck by the large number of cases in which the result was due to failure to control the local process in the lip. Obviously cure of the primary disease is a *sine qua non* of successful management, and no neck dissection, however radical, can rectify such failure. A final ap

TABLE V — RESULTS IN ALL NECK DISSECTION IN WHICH LIP LESIONS WERE CURED

	Total cases	Percent with positive node	Percent cures in positive node cases
Primary cases			
Nodes not palpable	131	10	80
Nodes clinically benign	90	27	80
Delayed dissection	17	70	33
Nodes clinically involved	83	36	30
Secondary cases	28	71	30
Total	371	27	38

praisal of the efficiency of neck dissection is presented in Table X in which are presented the results in all patients subjected to neck dissection in which the lip lesion was successfully cured.

There was a small but definite incidence of deaths due to recurrent disease also in the group submitted to neck dissection in which the nodes showed no evidence of disease.

Careful study was made of the cervical node recurrences after dissection, for the purpose of appraising the extent of the operation on the neck. Knowledge for this study is available in relatively few of the patients known to have died of recurrent malignancy. A total of 31 cases are known to have developed recurrence in the field of the neck dissection. In 12 instances the neck dissections had been performed elsewhere before admission to our hospitals. In 8 other cases, recurrence in the neck operative area was associated with recurrence in the lip as well. In the 11 remaining instances, we must conclude either that the condition was too far advanced for attempted cure by dissection, or that the operation was not extensive enough, or was improperly performed. In several instances the mandible was involved, or massive implantation occurred in the operative scar. In other cases an isolated node recurrence in the submental or buccal area indicated an incomplete dissection. In these cases a secondary dissection sometimes proved effective in bringing about a cure.

In 19 patients, recurrence is known to have taken place outside the area of a routine suprahyoid dissection. In 8 of these such recurrence was part of a generalized wide spread terminal involvement. Instances were noted of involvement of the preauricular, mastoid, low jugular, supraclavicular, and

TABLE VI — APPEARANCE TIME OF POSITIVE NODES

Years after onset of primary lesion	Positive nodes present	Years after onset of primary lesion	Percent of all cervical node recurrences
0 to 0.5	13	0 to 5	10
0.5 to 1	34	0 to 1	37
1 to 1.5	2	0 to 1.5	30
1.5 to 2	17	0 to 2	69
2 to 2.5	12	0 to 2.5	8
2.5 to 3	9	0 to 3	80
3 to 4	9	0 to 4	93
4+	9	Over 4	7

even axillary lymph nodes. Likewise we observed instances of involvement of sternum, clavicle, and upper ribs.

No relationship could be established between grade of primary carcinoma and the likelihood of developing recurrences either locally in the dissection field, or remotely. There was one operative fatality in the neck dissection series, from secondary hemorrhage.

Time of node metastases. Cases with metastatic involvement of the cervical nodes were studied to determine the time of appearance of node involvement after the onset of the primary disease. Data are available in 125 cases and are presented in Table XI.

These figures are of interest and value in determining the need for follow up observations for patients who are not treated primarily by neck dissection. It is allowable to subtract the average of 6 to 12 months elapsing before treatment of the original lesion is undertaken. Thus 3.5 years after the lip operation 93 per cent of cervical recurrences will have taken place. It is evident that surveillance should be most intense during this period, and especially during the first 2 years, when over three quarters of the recurrences occur.

It is impossible to emphasize too strongly that adequacy of follow up is the determining factor in the decision for or against prophylactic neck dissection in many cases. A policy of watchful waiting in regard to the neck is justifiable only if the patients will report regularly and conscientiously for examination. Ignorant or irresponsible patients, and those who live at remote points or for whom transportation problems are difficult, should not be trusted to report regularly. Likewise in sufficient or undependable social service

TABLE XII — THIRD ORDER ASSOCIATIONS—
SIGMA $\chi^2 (n=8)$

	High malignancy	Large size	Long duration	Positive nodes
Palpable nodes	11 14	27 40	8 05	91 78
High malignancy		31 43	6 46	86 84
Large size			19 22	12 13
Long duration				7 30

follow up crowded and undermanned clinics, and hurried or perfunctory examinations militate against the success of a policy of deferred neck dissections.

Of the 9 patients in whom metastases took place after 4 years several of the patients presented abnormally long durations of the primary lip lesion when they first presented themselves for treatment. In 4 instances cervical metastasis did not appear until over 8 years after the onset of the original lesion.

EVALUATION

On the basis of the data presented in Tables I to V it seems apparent that positive cervical lymph nodes are associated with lip lesions of longer duration, larger size, and higher grades of malignancy. Certainly if we assume that carcinoma starts as a localized process which forms metastases only after an interval of time it is a necessary corollary of this assumption that the longer a lesion is present, the more likely it is to present metastases. The size of a carcinoma is influenced by its rapidity and mode of growth and by its duration. Thus it is reasonable to associate increased likelihood of lymph node metastasis with increased size, both because of the implied greater duration and because of the greater rapidity of growth. Grade of malignancy is based on histological criteria which evaluate rapidity of growth, invasiveness, lack of host resistance, etc., which may be anticipated to influence the development of node metastases, and to be closely related to the size of the lip lesion and to the tendency to recur locally after excision. The observed increased incidence of cervical node metastases in patients presenting recurrence of the primary growth in the lip seems definitely to relate to the increased duration and greater invasiveness of the local disease in these cases. The outstanding characteristic of the lymph

nodes which is associated with metastatic involvement is the size of the nodes. Although our figures indicate a considerable fallibility of clinical appraisal, it is obvious that the presence of enlarged lymph nodes is our most dependable clinical evidence of metastatic involvement.

For further statistical analysis of the significance of these factors we subdivided our cases according to the following schedule:

- Duration—Short: less than 1 year
Long: 1 year or more
- Size—Small: less than 1.5 centimeters
Large: 1.5 centimeters or larger
- Grade—Low: Grade I
High: Grades II and III
- Size of nodes—Not palpable: less than 1 centimeter
Palpable: 1 centimeter or larger
- Pathology of nodes—Negative
Positive

These tabulations were submitted for analysis of partial associations, which are presented in Table XIII.

Thus by holding the various combinations of variables constant, associations are found to exist between palpable nodes and large size, palpable nodes and positive nodes, high malignancy and large size, and high malignancy and positive nodes. In addition a border line association is found between large size and long duration. Apparently large size has not been demonstrated to be of consequence except when it is associated with high malignancy or palpable lymph nodes. The border line association between duration and size is simply confirmation of the clinical fact that carcinoma grows larger the longer it is present. It is regrettable that statistical confirmation of the relation of duration to cervical node involvement is lacking. It is first of all to be remembered that data as to duration are extremely undependable. Secondly, it is probable that the interval of 1 year used as a dividing line between cases of long and short duration is too great. At the expiration of a year probably metastases have already occurred in practically all cases which tend to develop them. Finally, the degree of malignancy is of such overwhelming importance as to overshadow the significance of duration. It should

For the t t c t c l h s s w h c h t h table s has d w are n
d b d t Dr H L Lomb r d r e t f b d o f c and th
c h o c d s o f t h M s b u s t Dep rim t o f b l i c H t h

be realized that classification of cases according to two or three grades of malignancy is purely arbitrary, and that undoubtedly there are a large number of possible subdivisions in each of these grades. If a group of cases could be selected which was homogenous so far as its degree of malignancy was concerned, and if accurate data in regard to duration were available in terms of months, it is probable that confirmation of the significance of duration in relation to metastases could be secured.

The association between grade of malignancy and positive node involvement is very marked, even though for the purpose of the analysis Grades II and III were grouped together as high malignancy.

Indications for neck dissection. On the basis of the findings here recorded, it is possible to offer indications for carrying out neck dissection.

1 Cases without palpable lymph nodes or with nodes less than 1 centimeter in size. Provided this group of cases can be followed carefully, there does not seem to be sufficient likelihood of the development of cervical metastasis to warrant routine dissection. Prophylactic dissection is justifiable in highly malignant lesions, and in patients who for various reasons cannot be kept under proper surveillance. While our group with deferred dissection yielded fewer cures, it is probable that the explanation for this lies in the number of cases which really represented neglect, permitting the nodes to attain large size before dissection was carried out. Follow up must be most intense for at least 3 years after the local lesion has been cured, if cases are to be treated expectantly. We believe that observations should be monthly for at least 6 months after lip treatment, and bimonthly thereafter for 2 years.

2 Cases with lymph nodes larger than 1 centimeter. These patients should be given the benefit of neck dissection as part of the original treatment. We do not advise the treatment of the lip and neck at a single sitting. We believe that proper procedure consists in the following steps: (a) biopsy (b) dental clean up, extractions, treatment of pyorrhea, etc. At the same time an attempt can be made to combat sepsis in the local

lesion, (c) eradication of the local lesion by radiation or operation, (d) after healing of the wound of lip operation, or subsidence of most of the radiation reaction, the nodes should be reappraised as to size, consistency, etc., (e) neck dissection should then be carried out if the enlarged nodes persist, and especially if there is asymmetrical enlargement. In doubtful cases, dissection should be carried out if the primary lesion is of a higher grade of malignancy, or if it is a recurrent process in the lip. Dissection should also be considered in doubtful cases if the lesion is of large size, long duration, or of invasive character. It should be remembered that a small biopsy or a single section may not give a true picture of the grade of malignancy, and due weight should be given to strictly clinical characteristics commonly associated with rapid growth.

3 Neck dissection should not be carried out unless there is a considerable degree of confidence that the local process in the lip has been or can be cured.

4 The routine suprahyoid dissection, unilateral unless the lip lesion extends to the midline, is probably as extensive an operation as is necessary, provided it is properly performed. When there is obvious node involvement, a more extensive operation may be desirable.

5 Follow-up observations should be carried out intensively after neck dissection, with special attention to lymph node areas of the opposite side of the neck, and beyond the limits of the dissection. Secondary dissections are often successful if they are undertaken promptly.

6 It is difficult to define the border line between operability and inoperability in the cervical nodes. Fixation of nodes to the jaw or muscles or great vessels, extracapsular involvement, or multiplicity of nodes, especially if bilateral, argue for incurability. While occasional brilliant results may be achieved in apparently incurable cases by very radical procedures, such as jaw resection and the like, it is doubtful whether enough such favorable results ensue to justify the greatly increased operative mortality which inevitably follows the frequent employment of these measures. We have had no experience with combinations of surgery and interstitial radiation such as

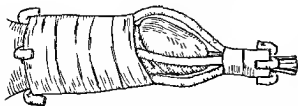


Fig. 1 Method of tying in catheter with wire pipe cleaners

ter therefore to rely on the total quantity of urea excreted rather than on the percentage and to regard the result of the test as bad unless more than one tenth of the original dose of urea be eliminated in each hour. In assessing the result of the blood urea it must be remembered that a rise is likely to occur only when the damage to the kidney is considerable. A percentage of urea below 50 is therefore no proof that the renal function is unimpaired. If however the reading is over 50 this will constitute definite evidence that the kidneys are deficient.

It cannot be emphasized too strongly that the results of the renal function test must always be correlated with information obtained from the clinical examination of the patient. However valuable the aid that the laboratory lends it is upon the clinical examination of the patient that the final decision as to whether it is or is not safe to operate finally rests. The fallacies that beset all renal function tests are numerous, most of them being due to the fact that the kidneys do not work at full pressure; in other words their potentiality is greater than that shown by any given test. It is this failure on the part of laboratory tests to estimate satisfactorily the reserve power of the kidney that is their chief limitation.

During the period of preliminary drainage everything should be done to encourage urinary excretion by the ingestion of larger quantities of fluids. As a rule all that is necessary is to instruct the patient to drink as much between meals as possible. Should however the fluid intake still remain unsatisfactory fluid must be administered by other routes (per rectum, subcutaneous or in serious cases intravenously).

THE INSTRUMENT

The instrument that has superseded all others in my own clinic for per urethral resection of the prostate is a modification of the McCarthy resectome (Fig. 2). The majority of these modifications have been introduced by Mr. Ogier Ward and Mr. Schranz of the Genito-Urinary Manufacturing Company (Fig. 1). The sheath as in

the case of the more recent American types is metal outside with the exception of the bakelite beak, a modification that allows of easier introduction. The length of the beak has been shortened, and to the end of it has been fitted an inclined plane which has the effect of pushing forward the loop as this is wound out of the sheath into the cutting position. Not only does this allow of its taking a wider sweep, but also of its remaining in the field of view, and under better control. The two taps on the irrigating channels have also been replaced by a single stop-cock, which according to its position allows of inflow or outflow only or else shuts off altogether the irrigating fluid. This is a considerable advantage in an operation in which attention has to be directed to so many different details. Since larger pieces of prostate can be cut away through the wider excursion of the loop it is possible to work with a smaller sheath than formerly was the case and one of the No. 26 Charrière scale will be found to be very efficient. Through the use of a smaller instrument this risk of damage to the urethra is considerably lessened.

TECHNIQUE OF OPERATION

Not only has the resectome been considerably modified but also the technique of the operation. If a sagittal section of the bladder, urethra and rectum be examined (see Fig. 3) it will be seen that there are two areas of danger, that is to say positions, in which the loop if it makes too wide an excursion runs the risk of cutting into important structures. The first of these is in the region of the trigone. Resection here may end in the subtrigonal structures being exposed and in the operation being followed by extensive suppuration in the space of Denonvilliers. I am convinced that certain instances of long continued suppuration among my earlier cases were due to infection of this space. The second dangerous area is the junction of the prostatic with the membranous urethra. It is in this area that the urethra lies in closest proximity to the rectum. In 2 of my cases resection has been followed by the passage of urine per rectum. Fortunately, the recto-urethral fistula so formed soon healed spontaneously in one case through the help of a temporary suprapubic drainage and in the other by means of the indwelling catheter alone.

If these two complications of extensive suppuration and recto-urethral fistula are to be avoided, great control must be exercised over the excursion of the loop. The danger area of the junction of the prostatic and membranous urethra can be avoided by keeping the upper part of the

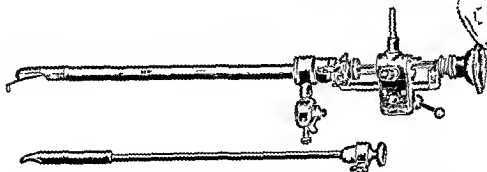


Fig. Modified McCarthy instrument. An inclined plane has been fixed to the beak of the sheath which has the effect of pushing the loop forward. For the inlet and outlet irrigating channels a single control has been substituted.

verumontanum as a fixed point throughout the operation, and never extending the cuts below this level. The second danger of opening into the subtrigonal tissues is avoided by adopting what Mr. Ogger Ward has termed "the method of sub-vesical resection of the prostate." In introducing this technique, he has pointed out that after the operation of prostatectomy by enucleation, the space that is left is quite different from that left after an ordinary per urethral resection. The cavity from which the prostate has been enucleated connects with the bladder through a comparatively small opening, and little if any damage has been inflicted on the trigone. If, in carrying out a per urethral resection we imitate this condition, and instead of allowing the loop to inflict damage on the trigone with each cut, only allow it to enter the bladder in the mid posterior line, not only will the risk of severe sepsis be avoided but also the highly vascular trigonal mucosa be left undamaged. To achieve this, it is necessary to resect tissue from around the prostatic urethra and from beneath the trigone without cutting into or in any way damaging this structure, except to a very limited extent in the neighborhood of the posterior midline.

The resection is carried out as follows. Beginning in the mid line posteriorly, the loop is first placed over the intravesical projection in the usual manner, until it is hidden from view, one or two such cuts are usually all that is necessary. After this the loop is not again allowed to enter the bladder cavity, but from now onward is kept in sight, pressed against the prostate itself within the urethral cavity, and at a level immediately below that of the internal meatus. Simultaneously with the turning on of the current, the loop is embedded in the tissues by pressing the beak of the sheath firmly in the required direction, and making the cut from there downward to the upper limit of the verumontanum. These cuts resect chiefly the lateral lobes but must be con-

tinued well round, so as to include the front of the gland on both sides. From time to time hemorrhage is stopped by the substitution of the ball electrode for the loop, and the coagulating for the cutting current. At the end of a per urethral resection conducted in this manner, if the instrument be withdrawn so that the objective of the telescope lies at the level of the verumontanum, one finds oneself looking into a recess which has been excavated beneath the bladder, and at the top of which there is to be seen a comparatively small opening into the bladder, in other words, the condition produced is very similar to that existing after an enucleation. Sooner or later a stage is reached when further cutting into the lateral lobes becomes mechanically impossible. The operation may now be considered to have been completed.

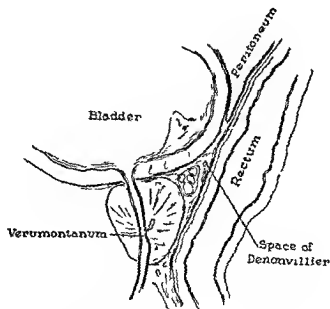


Fig. 3. Sagittal section through prostate and rectum showing the space of Denovilliers lying beneath the trigone and the proximity of the rectum to the urethra at the apex of the prostate.

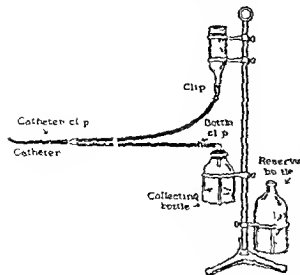


Fig. 4 Mark's hospital irrigating system for indwelling catheters

One of the difficulties that operators have always experienced has been the extraction of cylinders of tissue that have fallen into the bladder. A variety of patterns of forceps have from time to time been advised for extracting these, but in my opinion the easiest method is that practiced with the new form of McCarthy resectoscope. The telescope and loop are removed and a connecting piece between the sheath and a Bigelow evacuator are fitted on. This allows of fragments of prostate that have fallen into the bladder being sucked into the bulb in the same way as fragments of stone are extracted during the operation of lithotomy. It is of importance that this extraction be thorough, since the eye of the indwelling catheter will otherwise be occluded during the subsequent drainage.

Anesthesia I much prefer for anesthesia the use of a low spinal anesthetic. Not only does this obviate any necessity on the part of the operator to conclude the operation within the shortest time possible but it reduces the likelihood of hemorrhage. In a resection carried out under a general anesthetic bleeding is always more marked than in one performed under spinal anesthesia. The only disadvantage of a spinal anesthesia is that the vasoligature performed after resection in order to reduce the risk of epididymitis may not be entirely painless. This disadvantage, however, can easily be overcome by the additional use of a local anesthetic. It is in my opinion an advisable step in the operation since the risk of epididymitis appears to be at least as great after per urethral resection as after pros-

tatectomy. In one very bad case, a patient with severe myocardial degeneration operated on by me, I omitted this step, although patient withstood the shock of the resection, he died 3 weeks later from a suppurating epididymitis.

POSTOPERATIVE CARE

The final step in the operation has been the tying in of an indwelling urethral catheter. For this purpose I generally use a whistle ended rubber catheter with two lateral eyes. This can be inserted through the sheath before it is withdrawn and is tied in in the same way as a catheter used before operation. As soon as the patient has returned to bed the catheter is connected up with a St. Mark's Hospital irrigating apparatus (Fig. 4). This allows of the bladder being washed out frequently simply by manipulating the two clips on the rubber tubes fitted to the Y shaped connecting piece. It is the duty of the nurse to ensure that drainage is satisfactory and that the catheter has not become blocked by blood clot. If due attention has been paid hemostasis at the conclusion of the operation this is easily achieved, and in 24 or 48 hours all bleeding will have stopped. The precise nature of the antiseptic employed is of less importance than its mechanical action in washing out the bladder. Whenever bleeding is greater than it should be an occasional wash out with hot silver nitrate is useful as a hemostatic measure.

Since the maintenance of a good output of urine is an essential part of postoperative treatment it is important that the patient should be encouraged to drink as much fluid as possible. Should the intake be unsatisfactory the oral fluids must be supplemented by fluids administered per rectum subcutaneously, or, in more urgent cases intravenously.

The length of time that the catheter is left in the urethra will depend on several factors the duration of hemorrhage the severity of sepsis and the amount of tissue resected at the operation. If the patient is comfortable and no urethritis is present I prefer to leave the catheter in position for a week or even 10 days. When it has been withdrawn continuous drainage is replaced by intermittent catheterization in order that the amount of residual may be measured and the bladder washed out. Only when the emptying of the bladder is considered satisfactory and the urine clear should the patient be discharged from hospital.

COMPLICATIONS

The main complications of a per urethral resection are renal failure sepsis and hemorrhage have

already been dealt with. All that need be referred to here is the treatment of cases in which hemorrhage and sepsis are so severe as not to respond to usual methods.

Severe hemorrhage may be either reactionary or secondary but the former will seldom be met with if proper attention has been paid to hemostasis before the patient leaves the operating theatre. The main anxiety of the medical man responsible for the safety of the patient who is bleeding more than he should is to maintain the bladder drainage. Fortunately, the type of catheter used allows of clots being ejaculated through the terminal opening by the use of a bladder syringe. It may happen, however, that so much bleeding has taken place as to cause clot retention. Before resorting to opening the bladder above the pubis it is worth while attempting to digest the clot by injecting 2 ounces of glycerine of pepsin. In certain cases it will be found that after injecting this fluid the clots have been sufficiently digested to allow of their evacuation through the catheter. If, however, catheter drainage is no longer satisfactory no hesitation

need be felt in opening the bladder above the pubis and inserting a tube.

Serious sepsis must be treated by frequent bladder irrigation and by the use of either calcium mandelate or sulfanilamide. Should severe infection have occurred prior to operation, and the patient be of the type who will resent the presence of an indwelling catheter, it is better to carry out a preliminary drainage in order to get the bladder into a healthier condition. Provided all obstruction has been removed a suprapubic fistula will close within a few days of the removal of the tube, and the duration of convalescence is very little increased by the carrying out of a suprapubic drainage. No hesitation need be felt therefore in making this addition to the operation if the patient be intolerant of instrumentation, if a prolonged period of drainage be necessary, if pre-operative sepsis is severe or if hemostasis at the conclusion of the resection is considered unsatisfactory.

REFERENCE

1. WARD R. OSTER. Brit. M. J. 1938 2 173.

TECHNIQUE OF SUBTOTAL GASTRECTOMY FOR ULCER

FRANK H. LAHEY, M.D., F.A.C.S. and SAMUEL I. MARSHALL, M.D., F.A.C.S.

Boston, Massachusetts

DURING the past few years there has been a gradual but very definite change in the method of handling the patient with gastric and duodenal ulcer. There has been the change from the situation in which opinions were divergently divided into those advocating surgery for nearly all ulcers and those advocating non-operative measures except when urgent complications such as perforation, obstruction or malignant degeneration occurred. There is very little disagreement today with the more modern attitude that no ulcers are primarily surgical, that all ulcers should be given a trial of non-operative treatment and that all patients with ulcers should have surgical treatment only as the ulcers fail to respond under the trial of medical measures. Practically everyone is in agreement with the surgical indications which we have frequently discussed, namely, ulcers which are intractable to medical management, those in which two or more gross hemorrhages have occurred in spite of good treatment, those which have perforated, pyloric obstruction which is not amenable to medical management, and gastric ulcers in which the question of malignancy cannot be definitely settled.

Although the relationship of surgery to non-operative measures has been quite definitely established, there has been lack of agreement during the past few years as to the desirability of employing conservative operative procedures such as gastro-enterostomy, gastroduodenostomy, or various forms of pyloroplasty with or without the excision of the ulcer, or whether or not more radical procedures such as subtotal gastrectomy should be employed.

It seems to us that subtotal gastrectomy has now been more and more generally accepted throughout this country and England, the two countries in which acceptance of the method when first advocated by continental surgeons was most strenuously resisted.

There were certain psychological reasons that made the acceptance of subtotal gastrectomy for peptic ulcer difficult for all of us. It was particularly difficult for everyone to accept the plan of removing large portions of the stomach for an

ulcer no larger than one's little finger nail. It was particularly difficult also to accept this procedure when many of the patients with the lesion, although uncomfortable, were able to be up and about and with the aid of alkalies and frequent feedings to struggle through the years suffering only periodic attacks of discomfort and disability. It was further difficult to accept this radical operative procedure because up to the time that one becomes expert with it, the mortality rate is distressing and a fatality in a patient who is not in a condition of acute abdominal emergency, who is able to be up and around and at times at least to support himself partially, is a particularly depressing and distressing one. For these reasons it was but natural that subtotal gastrectomy as a method of surgical treatment for gastric and duodenal ulcer was accepted only after having met with considerable resistance and among the prominent resisters it is but fair to say that we ourselves were included.

Haberer and Finsterer who did pioneer work in Europe and in this country, and Berg, Lewis, Sohn, and Strauss deserve a great deal of credit for their persistent advocacy of this method of surgical treatment in the face of vigorous and at times almost bitter criticism.

It is being more and more accepted, as we have repeatedly said, that conservative surgical procedures such as gastro-enterostomy and pyloroplasty are no longer justifiable as routine operations for patients with gastric and duodenal ulcer. The too frequent occurrence of gastrojejunal ulcer so intractable to medical management and the occasional incidence of gastrojejunal colic, fistula, a lesion with a disturbing mortality rate, has led a great many surgeons to avoid the routine use of these conservative procedures.

While we feel entirely in sympathy with the selection of subtotal gastrectomy as the method of choice in the surgical treatment of duodenal and gastric ulcer, nevertheless we think that lest our attitude be misinterpreted it is but fair to say that occasional cases will arise in which it would be unsafe and unwise to apply subtotal gastrectomy. It would be a mistake, we believe, for anyone dealing with gastric and duodenal ulcer to take the attitude that all patients with

From the Department of Surgery, The L. Hey Clinic.



Fig 1 This roentgenogram shows the small amount of stomach left after the subtotal gastrectomy *non* employed at the clinic. Note how well these anastomoses without entero enterostomy drain

gastric or duodenal ulcer regardless of their age, condition, weight or location of the ulcer should be submitted to subtotal gastrectomy. We be-

lieve very strongly that in bad risk cases it is infinitely better to perform an operation with which one is not as well satisfied but to which is

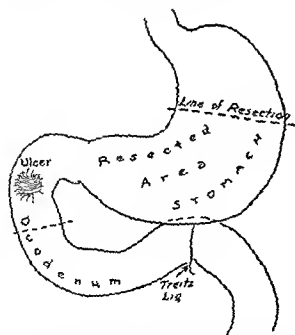
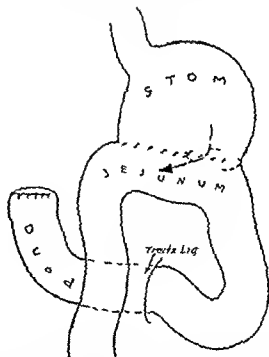


Fig 2 left 1 diagrammatic sketch solely to demonstrate the amount of stomach and duodenum resected

Fig 3 Diagrammatic sketch of the principle of the Hofmeister procedure. Note the closure of the upper half of the transected stomach, the anastomosis established at the lower half, and the loop of the jejunum buttressed over the upper closed half of the stomach. In this illustration



the proximal portion of the jejunum is shown attached to the greater curvature of the stomach. This is occasionally done when the position of the jejunum is such that the jejunum falls naturally in this relationship, but more frequently the proximal loop of the jejunum is anastomosed to the lesser curvature of the stomach.

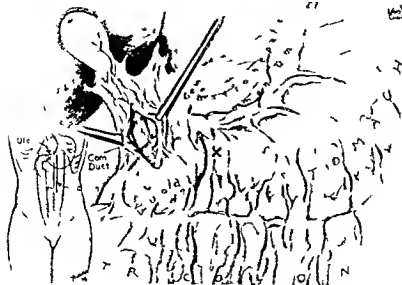


Fig 4

Fig 4 In the insert shown in the lower left hand corner the relation of the incision to the stomach and duodenum can be seen. We have routinely employed a left rectus incision because it permits an easier approach to the gastric vessels high up on the lesser curvature. With the traction tape applied to the stomach as is shown in Figure 5 the duodenum is pulled up and toward the middle line so that approach to it through the left rectus incision is quite easy. Although resection can be done readily either through a midline or right rectus incision it is our experience that it is easier to mobilize the duodenum toward the left and to deal with it satisfactorily than to mobilize high levels of the lesser curvature and the esophagus to the right and to deal with them satisfactorily through a right rectus incision. In the main illustration note that particularly in duodenal ulcers one of the first things accomplished is to establish the relationship of the ulcer in the duodenum to the common bile duct. This is most important. We have seen duodenal ulcers so close to the common bile duct that when the duodenum was resected unsatisfactory amounts of duodenum remained to be turned in. For that reason one of the first steps in total gastrectomy is to demonstrate the relationship of the ulcer to the common bile duct.

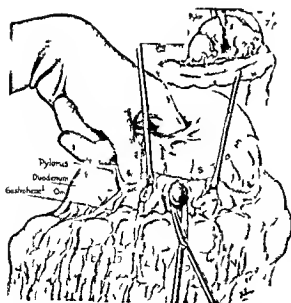


Fig 5

Fig 5 The finger is shown entering the lesser peritoneal cavity by breaking through the gastrohepatic omentum and emerging through the gastrocolic omentum. Note in the insert the introduction of a strip of gauze traction upon which pulls the duodenum up out of its deep location in the right upper quadrant so that the duodenum approaches the midline and can be dealt with readily. This greatly simplifies exposure of the duodenum.

attached a lower mortality rate. We believe from our experience that occasionally there are patients with indurated ulcers low in the duodenum close to and even involving the common bile duct with a marked degree of pyloric obstruction in whom subtotal gastrectomy cannot be done with safety because of the fact that there would be insufficient duodenum left for safe inversion of its end. In

such a patient the operation of Finsterer here described in Figure 16 in which the ulcer is left in place occasionally cannot be done because of the fact that the pylorus is obstructed and the remaining stump therefore will not drain. We think that every patient with ulcer who is approached surgically should be considered as to the possibility of subtotal gastrectomy and estimated

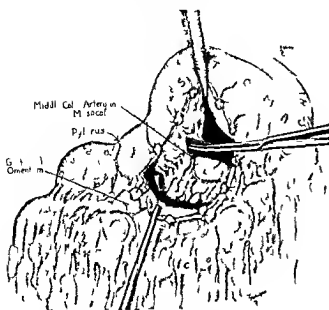


Fig 6

Fig 6 Partial ligation of the vessels in the gastrocolic omentum and the separation of the lower end of the stomach from its attachment to the pancreas is shown. Note again the value of the traction tape.

Fig 7 Further ligation of the vessels along the greater curvature. Note now the separation of the duodenum from the head of the pancreas. Separation of the duodenum from its retroperitoneal attachment is accomplished much more easily from below upward by rolling the duodenum upward than from above downward.

Fig 8 With the vessels in the gastrocolic omentum ligated and the duodenum freed from below and behind the vessels of the lesser curvature in the gastrohepatic omentum are now ligated. Note the dotted line showing the level at which the stomach is to be resected. Note also that the peritoneum has been incised over the common bile duct to show its relationship to the ulcer.

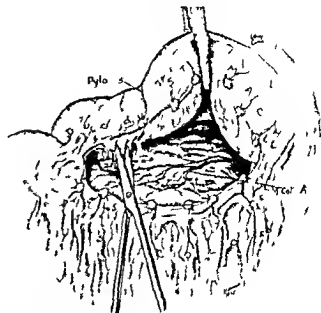


Fig 7

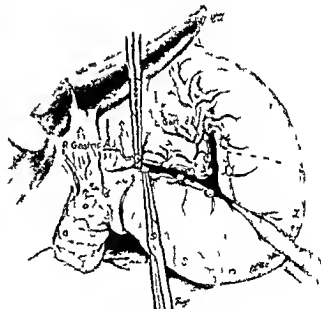


Fig 8

upon the basis of his general condition, age, weight, and the location of the ulcer, and then only should the operative procedure be selected.

In a follow up study of 200 cases in which subtotal gastrectomy has been done for ulcer it has been demonstrated to us that the end results, at least so far, are superior to those obtained by the use of the more conservative procedures, namely, a gastroenterostomy or pyloroplasty. There are fewer recurrent ulcers and the incidence of digestive difficulty after operation is also greatly lessened.

It has seemed to us that it would be of value to present in illustrations and legends the technique of the now relatively standardized subtotal gastrectomy to which we have come after a considerable experience with various types of operative procedures. Up to September 28, 1938, we have handled 362 cases.

It has also seemed to us that it might be of value, comfort, and perhaps encouragement to

other surgeons to report our mistakes and to state that there has been no operation in our experience in which it has been more difficult for us to overcome complications and in which it has been more difficult to reduce mortality than in that of subtotal gastrectomy. It seems to us that there is no operation in which a relatively large experience and frequent practice is more important and more necessary than that of subtotal gastrectomy if the mortality rate is to be reduced and kept low.

There is no operation with which we have had experience in which co-operation between gastroenterologists in the preparation of the patient and

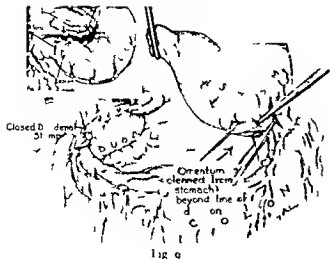


Fig. 9

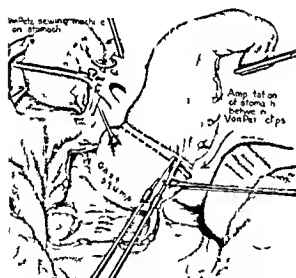


Fig. 10

Fig. 9 In the insert in the upper left hand corner the stomach is shown freed and with all of its vessels ligated. In the main illustration the duodenum has been severed and turned up and a few more vessels are being ligated in the gastroduodenal omentum to control all blood supply up to the level of the dotted line shown in the insert. The level of transection of the stomach. Note in the main illustration the relationship of the middle colic artery in the mesentery of the transverse colon.

Fig. 10 The two methods employed in closing the duodenal stump a and b. The duodenum is grasped between 2 Ochsner clamps and severed between these clamps with the cautery the ends being sterilized care being taken to leave in the lower clamp a small grasp of duodenal tissue. The free duodenal tissue projecting above the level of the clamp is then clamped with a row of Allis forceps. The first Allis forceps as shown in a is taken off and a continuous catgut stitch continued. As each Allis forceps is taken off a lock stitch is applied until the entire duodenum is closed. A continuous catgut stitch

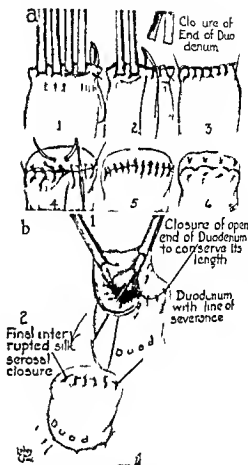


Fig. 11

now buries this crushed region and a reinforcing layer of interrupted silk mattress stitches is then applied. In b the method now most commonly employed in this clinic is shown. As in a the duodenum is grasped by 2 Ochsner clamps and is severed with the cautery between these two clamps and the lower clamp is removed. Following the removal of the Ochsner clamp the ends of the duodenum will remain stuck together. Allis forceps are used to pick up the duodenum one end is gently opened and a suction apparatus is immediately introduced to suck out its content. The open end of the duodenum is then inverted by a continuous Connell in and over stitch. This is returned to invert the first layer and a third layer of interrupted mattress silk sutures as shown in b is then introduced.

One of the most important steps in subtotal gastrectomy is the preservation of sufficient duodenal stump so that it can be accurately inverted and adequately sutured so that there is no danger of leakage from it. Either of these methods preserves the entire available duodenum. The method which involves over and over suture of a clamped duodenum using up from $\frac{1}{2}$ to 1 inch of the duodenum may result in such a short stump of duodenum remaining that inversion and closure must be done under tension.

Fig. 11 With the duodenum closed and with the blood supply of the stomach ligated the stomach is turned upward over the left edge of the wound and as shown in the insert in the upper left hand corner the von Petz se ing

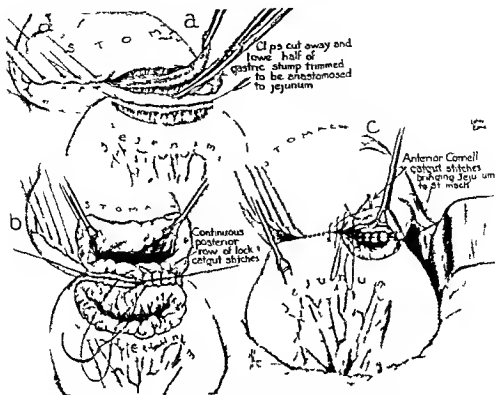


Fig. 12

clamp is applied inserting as it does as shown in the main illustration two rows of non absorbable metal clips between which one may burn with the actual cautery to transect the stomach. Note that the stump of stomach is held by Babcock forceps so that it does not retract into the left hypochondrium.

For purposes of illustration no gauze is wrapped around that portion of the stomach which is to be removed but in the actual operation a protecting strip of gauze is wrapped around the Ochsner clamp at its pyloric portion.

Note also that the wound edges are protected by the cellophane pads which we employ and have described a single strip of cellophane being placed between two layers of gauze about 18 inches square. The edges of the gauze are hemmed by the nurses autoclaved and before using soaked in salt solution. Upon wetting these pads they become soft and pliable and cling readily to the edge of the wound as they are draped around it to protect the wound. We have used these pads now for some years and feel certain that they play a considerable part in protecting wound edges from contamination.

Fig. 12 The upper half of the gastric stump which has been closed by the clips in the von Eitz sewing machine is closed first by a continuous row of catgut sutures then by inverting this row of sutures with another layer of continuous Cushing's catgut sutures and finally by an interrupted layer of mattress silk sutures as shown in a.

The ligament of Treitz not shown in this illustration is now located and a long loop of the jejunum brought up over the transverse colon to be approximated to the lower half of the transected stomach. As is shown in a this loop of the jejunum is attached to the posterior wall of the stomach by a layer of interrupted black silk sutures. The jejunum is incised through all of its coats for a distance to correspond to that portion of the stomach which is to be anastomosed to it.

After this procedure a small opening is then made with scissors in the lower portion of the stomach of sufficient size to admit only a suction tube into the gastric stump. With this suction tube before any larger opening is made the gastric stump is sucked thoroughly dry of its content. When the stump is thoroughly dry that portion of the stomach containing the clips is cut away for the entire distance which is to be anastomosed to the jejunum. As shown in b a second layer of a continuous posterior row of locked catgut stitches is applied between the stomach and the jejunum. The posterior layer of continuous locked stitches is continued in c as an in out and over Corneil suture in order to complete the inner row of anastomotic sutures.

We feel sure that it is not necessary to get out all of the metal brads as we have repeatedly made this anastomosis over metal brads left in the cut edge of the stomach and have never seen any bad results from it.

in the management of the active stage of the ulcer before coming to surgery is more necessary than in this one. Certainly there is no operation in surgery in our experience in which the type of anesthesia plays a greater part not only in relation to the ease with which the operation can be done but more particularly to complications such as

pulmonary complications wound infections, and obstruction after operation.

We have passed through several phases of the employment of different types of anesthesia. Our first operations were done under ether and it soon became evident that this type of anesthesia was not desirable due to the length of time necessary to

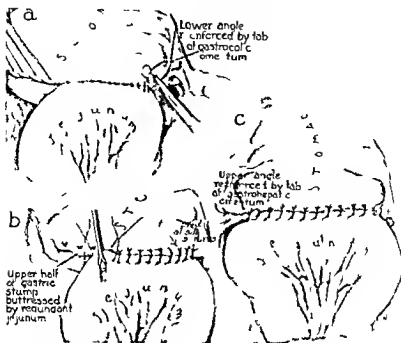


Fig 13

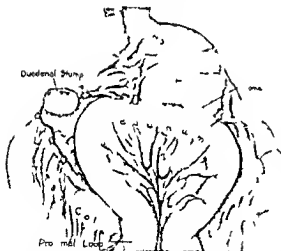


Fig 14

Fig 13 a The completed Connell catgut suture with the upper end of the stomach closed. In b the anterior row of catgut sutures is covered by a row of interrupted black silk sutures. Note the method in b of buttressing the jejunum over the upper closed half of the stomach by placing silk stitches between the posterior and anterior wall of the stomach and the jejunum thus securely reinforcing this suture line with the buttressed jejunum.

In c the complete anastomosis is seen the lower half is occupied by the anastomosis the upper half of the stomach serving to buttress the excess jejunum over the closed

upper half of the transected stomach. Note also that as the last stitch on the lower curvature is tied a tab of gastrohepatic omentum is tied in it to reinforce the angle and to suspend the suture line and in the lower angle likewise a tab of gastrocolic omentum is tied into the last lower stitch to reinforce this angle. This may also be seen in the lower angle in a. This we believe has been a valuable procedure in suspending the line of anastomosis and in reinforcing the upper and lower angles.

Fig 14 This shows the *Holmes* ter anastomosis completed. In it may be seen the closed duodenal stump the jejunum buttressed over the upper half of the stomach the gastrohepatic omentum tied into the upper angle and the gastrocolic omentum tied into the lower angle of the anastomosis.

One of the purposes in presenting this illustration is to mention particularly the length of the jejunal loop necessary to approximate it to the transected end of the stomach without tension. One must realize when the length of jejunum required is estimated that when the anastomosis between the jejunum and the stomach is made the stomach is under tension pulled as it is down into the wound. One must also realize that after the anastomosis is made the stomach will retract into the left hypochondrium and that if a short length of jejunum is brought up over the transverse colon to anastomose to the cut end of the stomach when that structure retracts the suture line may be under considerable tension. It is therefore very important we believe to pull out plenty of jejunum and then to pull out quite a little more allowing for this retraction of the stomach into the left hypochondrium. We have seen no disadvantage in the long jejunal loop. Here the proximal loop of the jejunum is shown anastomosed to the lesser curvature of the stomach as is so frequently our custom. Note also that no jejunojejunostomy is employed.

complete many of these complicated procedures and due to the fact that undesirable depths of

anesthesia were necessary in order to obtain relaxation sufficiently adequate to get the exposure

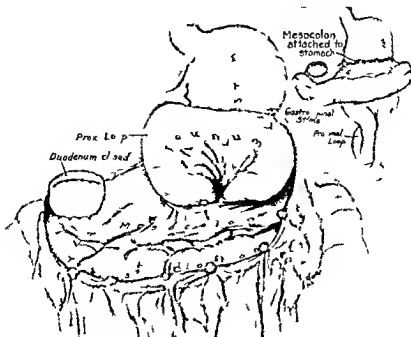


Fig 15

Fig 15 Although we now prefer antecolic anastomoses of the jejunum to the cut end of the stomach there will be cases occasionally in which because of a short jejunal mesentery or a very thick fat omentum it will not be feasible to make satisfactory antecolic anastomoses. For that reason this illustration is shown depicting the method of making posterior anastomoses and as shown in the insert in the right upper corner the method of attaching the cuff of the mesocolon to the stomach above the line of anastomosis to make the anastomosis within the greater peritoneal cavity. In our experience there will be cases occasionally in which it will be almost impossible to accomplish this attachment of the mesocolon to the stomach above the line of anastomosis.

Fig 16 The method of resection by exclusion according to Finsterer. This has proved a very useful procedure for us in patients in whom the ulcer was so close to the common bile duct that it did not seem feasible to undertake its removal. It has likewise proved valuable in bad risk patients in whom it did not seem feasible to spend the time necessary for the dissection of an indurated adherent ulcer on the posterior wall. Note that the stomach has been cut off proximal to the pylorus and turned in a subtotal gastrectomy will then be done up to the level shown by the dotted line. We have employed this procedure in 10 cases. It has been quite satisfactory. In 15 such patients followed the end results have been just as satisfactory as those in whom the ulcer had been removed. One must not employ this procedure unless it is certain that there is no pyloric obstruction. Unless there is free drainage through the

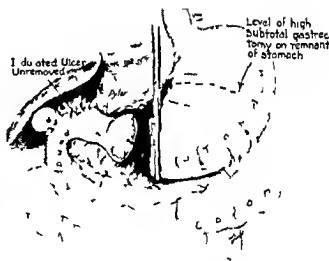


Fig 16

pylorus fluid will accumulate in the small gastric stump and rupture the sutured end of the distal gastric stump. Failure to realize the presence of a sufficient degree of pyloric obstruction to interfere with drainage brought about the only fatality which we have had in the 19 patients in which the Finsterer resection by exclusion was applied.

with which to do high gastric resections. Following the abandonment of ether we employed spinal anesthesia in the form of spinothane. The disadvantage of this anesthesia was its inadequate time length. Often these patients under spinothane would come out of their anesthesia at the end of an hour to an hour and a quarter, at the latest an hour and a half. This was particularly undesirable since at this time many of the patients

frequently had marked drops in blood pressure. In spite of this, it was still necessary to administer a general anesthesia and carry these patients into considerable depths in order to maintain the relaxation necessary to do high sutures in the extensive resections. This combination of anesthetics, therefore, was soon given up and we turned to intratracheal ethylene combined with regional anesthesia and splanchnic block. This

proved to be a very satisfactory anesthesia. Many subtotal and some total gastrectomies were done under this form of anesthesia. While intratracheal ethylene alone did not provide sufficient relaxation for the comfortable performance of high subtotal gastrectomy, quite adequate relaxation was obtained when a regional infiltration with novocain was added, and when to this was added novocain sphinctric block, greater relaxation and less drop in blood pressure were secured.

It was not however until the advent of dilute nupercaine solutions as advocated by Howard Jones of London that a really satisfactory anesthesia was obtained for subtotal gastrectomy. We have now employed dilute nupercaine spinal anesthesia in a 1:1:500 dilution for about 3 years in high upper abdominal operations with complete satisfaction and it appears to be the nearly ideal anesthetic particularly for subtotal gastrectomy. With dilute nupercaine spinal anesthesia complete relaxation now can be obtained up to 3 or 3½ hours and even longer. There have been no undesirable complications with this type of anesthesia and it is the opinion of our anesthesiologists that the drops in blood pressure are even less with nupercaine anesthesia than with the other types of spinal anesthetics, pontocaine and novocain. For those who have had earlier experience with nupercaine in spinal anesthesia it is but fair to state that the early use of nupercaine anesthesia in concentrated solutions had associated with it many serious complications which have been overcome by the employment of the dilute solutions.

Before presenting the description of our technical procedures in subtotal gastrectomy, we wish to say a few words regarding other types of operation for subtotal gastrectomy. We have occasionally employed the Billroth I type of subtotal gastrectomy. In our opinion however it has no place in the radical surgical management of peptic ulcer. Due to the fact that the duodenum in duodenal ulcers which will represent the majority of the ulcers, or 9 to 1 with which we have to deal surgically, is usually indurated and scarred as a result of the ulcer, this structure is not well adapted under these conditions for anastomosis to the cut end of the stomach. Due to the fact also that one is always interested in being able to bring the stomach over so that it can be anastomosed directly to the open end of the duodenum, there will be the constant tendency to leave sufficient stomach so that this can be done while the reverse should be true. If one is to accomplish the highest degree of relief for patients with intractable ulcer, then extensive re-

sections of the stomach must be undertaken and there must be no hesitation or uncertainty about the amount of stomach to be removed.

Early in our experience a few of these patients were managed by the Billroth II plan of procedure. This operation is likewise open to the same criticism due to the fact as with the Billroth I there is the tendency to leave sufficient stomach so that the ends can be turned in and a gastro-enterostomy established between the two. Both of these operative procedures have been entirely given up in this clinic for several years.

Many of our early subtotal gastrectomies were done by the so called Polya method frequently spoken of in the literature as the Reichel Polya operation. This operation has been quite satisfactory but has been supplanted for some years in our hands by the Hofmeister operation in which the upper half of the stomach is closed as shown in Figure 2 and the jejunum anastomosed to the lower half of the cut end of the stomach. This has as will be discussed the advantage of a shorter suture line and less danger of leakage.

In the beginning of our experience with subtotal gastrectomy the anastomosis between the cut end of the stomach and the jejunum was made with the jejunum behind the transverse colon as a posterior anastomosis. This necessitates the suture of the mesentery of the colon about the stump of the stomach in order to make the anastomosis between the end of the stomach and the jejunum rest in the greater peritoneal cavity. When subtotal gastrectomy is sufficiently high so that an adequate amount of stomach is removed it is impossible in many cases to suture the rent in the mesentery about the stomach satisfactorily and without angulation of the colon. For that reason one of us (F.H.L.) designed and published a method of posterior anastomosis whereby the proximal loop of the jejunum was transplanted above the mesocolon with but one loop of the jejunum passing through the rent in the mesocolon, thus cutting down the danger of obstruction to the proximal or distal loop. For the past few years posterior anastomoses have largely been given up and as will be shown in the operative illustrations practically all anastomoses between the cut end of the stomach and the jejunum are now made antecolic in location. This has distinctly lessened the incidence after operation of obstruction to the loops of the jejunum going to the stomach.

Early in our experience when the jejunum was brought over the transverse colon in the antecolic

position and had been anastomosed to the cut end of the stomach, entero enterostomy was done between the loops. This additional step to the operation was employed because it was feared that obstruction might occur at the point of anastomosis of the jejunum to the stomach. That has been given up entirely for some years and antecolic anastomoses with long loops of the jejunum are done with no entero enterostomy. The reasons for this are (1) that it has been definitely proved to us that entero enterostomy is not necessary and is even undesirable. If the purpose of subtotal gastrectomy is to remove the largest amount of acid bearing glands and to cause to flow into the stomach the alkaline upper jejunal contents for neutralization of any remaining acidity, then the addition of an entero enterostomy to a subtotal gastrectomy with antecolic anastomosis will sidetrack the alkaline jejunal contents into the jejunum, when it would be more desirable for these alkaline contents to flow into the stomach and there further neutralize acidity.

In the beginning of our experience with subtotal gastrectomy the operative procedure was conducted with clamps upon the stomach to prevent soiling. For a number of years now all subtotal gastrectomies have been done with no clamps whatever. When one attempts to apply clamps well up under the left costal margin the application of these clamps will of necessity limit the height to which the resection can be done, and, if the clamps are applied and the stomach then cut off, because of its high location, there will not infrequently be slipping of the clamps and spilling of the contents. Based upon our experience with these cases, we do not believe that it is possible to do adequately high subtotal gastrectomies, as shown in the roentgenograms of

patients who have had subtotal gastrectomies (Fig 1), unless these operations are done without clamps or with a special procedure done with special clamps as for instance the Shumaker clamps.

The accompanying illustrations with their legends so graphically illustrate the technique of the operative procedure that additional description is unnecessary.

It is our opinion that an operation of this magnitude, should not be discussed without presenting the mortality rate which has occurred in a series of cases. Up to September 28, 1938, 200 subtotal gastrectomies for ulcer have been done. Up to 2½ years ago the mortality was 18 per cent, by far too high. From 2½ to 1½ years ago, the mortality dropped to 11 per cent which was still too high. For the last year and a half the mortality has been zero. We have now done radical subtotal gastrectomy upon 51 consecutive patients without a single death. That these are not selected cases is evidenced by the fact that out of 3,500 ulcer patients treated in the clinic, only 8 per cent of the patients with duodenal ulcers and 23 per cent of the patients with gastric ulcers were submitted to surgery. In order that there may be no misunderstanding about these figures, every one of these patients had been submitted to prolonged medical treatment which failed to relieve symptoms, all of the ulcers were posterior wall eroding ulcers, and included in these 51 cases were 8 gastrojejunal ulcers which necessitated resection of the jejunum as well as the stomach, and 1 gastrojejuno-colic fistula which involved not only resection of the stomach and the jejunum but also resection of the terminal ileum, ascending colon, and right half of the transverse colon.

TREATMENT OF FRACTURES OF THE PELVIS

S M LEYDIG MD and J ALBERT KEY MD FACS

St. Louis Missouri

FRACTURES of the pelvis are commonly regarded as very serious injuries and rightly so because the pelvis is an elastic ring of heavy bone and when a person is subjected to sufficient force to cause a fracture of the pelvis that force is also apt to cause other injuries which may be serious or even fatal. However in the majority of instances the fracture itself is not dangerous to life or even a cause of permanent disability and it is the injuries to the pelvic viscera or the accompanying injuries to other parts of the body which have given the pelvic fractures a bad reputation.

Likewise it is generally believed that the treatment of fractures of the pelvis is a very complicated procedure which demands considerable mechanical ingenuity on the part of the surgeon and great fortitude on the part of the patient. And this belief is supported by recent articles on the subject (Jahass Carruthers Stern Langin Jones Noland and Conwell McBride Leadbetter Foster and Kasman and Conway) and even by a rather cursory perusal of recent textbooks on fractures (Key and Council). More careful study will reveal that the elaborate pieces of apparatus and apparently difficult procedures illustrated in the literature are used only in certain unusual fractures of the pelvis in which the fragments have been displaced in such a manner that good surgery demands that an attempt should be made to improve their position before they be permitted to unite. And one is very apt to forget that the great majority of fractures of the pelvis are simple fractures without sufficient displacement of the fragments to warrant interference and that those fractures require no specific treatment.

During the past 6 years 184 patients suffering from fractures of the pelvis were admitted to the Saint Louis City Hospital and it is interesting to note that 78 per cent of these patients were injured in automobile accidents and that during the past 2 years there has been a rather marked increase in the number of such fractures. The number in each year is as follows: 1932 27 cases 1933 18 1934 1 1935 22 1936 38 and 1937 58. During this period we have had occasion to

try various forms of treatment and have gradually simplified our procedures until we now believe that our pelvic fractures are treated adequately but are not over-treated and the principal reason for writing this paper is to emphasize the fact that the great majority of fractures of the pelvis do not require any specific treatment of the fracture and are more comfortable and in general do better if they are simply put to bed and given good nursing care and symptomatic treatment.

In the past we have immobilized our pelvic fractures in double plaster of paris spica casts. These were abandoned for various forms of swaths and belts of which perhaps the high water mark was a belt made of a split section of an inner tube from an automobile tire which was provided with laces and enabled us to obtain any desired amount of elastic compression. In addition to the swaths and belts we have used various forms of slings suspended by ropes and counterbalanced by weights equal to about half of the weight of the patient. These were equipped with spreaders the spreader being wide where little lateral pressure was desired and narrow or absent when lateral pressure was indicated. We have also combined the above with various types of traction on one or both extremities.

As our experience with these fractures has broadened we have gradually abandoned all forms of active treatment which had no specific purpose. The methods which we now use will be discussed later and the reasons will be given for employing them.

When confronted by a severely injured patient the first concern of the physician is the patient's general condition. If he is in a state of profound shock efforts are made to combat this without subjecting him to a physical and x-ray examination. If a fracture of the pelvis is suspected an x-ray of the pelvis is indicated because by no other means can one learn the details of the fracture. If the pelvis is fractured it is important to learn whether or not the genito-urinary tract has been injured because ruptures of the urethra or bladder if present demand immediate treatment. Consequently the urine (obtained by catheterization if necessary) should be examined as soon as possible. If clear urine is obtained lesions of the genito-urinary tract can be ruled out, but if the

urine contains blood or if blood is present in the urethra or bladder a genito-urinary lesion is present and should be treated immediately.

A discussion of the treatment of fractures of the pelvis should consist of two parts (1) treatment of the complications of fractures of the pelvis, and (2) treatment of the fracture itself.

1 Complications of fractures of the pelvis Due to the fact that most fractures of the pelvis are due to violence which involves much or all of the body, these fractures are often complicated by other injuries which are frequently more important than the pelvic lesion and usually demand immediate treatment, while the pelvic fracture can wait until the complications are taken care of. It is beyond the scope of this paper to discuss the treatment of the various complications, but the more important will be mentioned.

Probably the most important and a rather frequent complication is surgical shock, and this was the most frequent cause of death in our series in which the mortality was 7.8 per cent. The degree of shock varies greatly and when severe demands immediate treatment. There are many fractures of the pelvis which occur in persons who are killed outright by falls from a height, crushing injuries or automobile accidents which are never diagnosed. The same is true of patients who die soon after admission to the hospital.

In patients with fractures of the pelvis the shock, if present in sufficient degree to cause concern should receive immediate attention and the fracture of the pelvis may be ignored for the time being. After the patient's general condition has improved sufficiently to warrant interference, visceral lesions and any accompanying fractures of other bones which may be present are treated.

The most frequent visceral lesions are those of the genito-urinary tract. These occurred in 23, 12 per cent, of our patients and were diagnosed as follows: Lacerations of the urethra, 3, perforation of the bladder, 4, contusion of the bladder, 5 and genito-urinary lesions of an undetermined nature, 11. This last group showed gross blood in the urine which cleared up after a few days. The mortality is higher in the patients with genito-urinary lesions (22 per cent in our 23 patients as compared with 7.8 per cent in the entire series of 184 fractures of the pelvis).

A rather important and relatively frequent complication of fractures of the pelvis is fracture of other bones. These are particularly frequent in those due to automobile accidents. When other fractures are present, treatment of these should be begun as soon as the patient's general condition permits and carried out along standard principles

with due regard to the fact that the patient must remain recumbent while the pelvic fractures are uniting.

Rare complications are injuries of the rectum, thrombosis of large veins, and injuries of the large nerves. In our series there were no injuries of the rectum or of the great vessels and there was only one nerve injury of sufficient importance to be recognized. This last was an incomplete lesion of the sciatic nerve in which the paralysis cleared up spontaneously in a few weeks. This is in sharp contrast to the findings of Lam, who stated that 9 per cent of pelvic fractures were complicated by nerve lesions. We agree with Wakely's opinion that the large size of the foramina of exit in proportion to the size of the nerves is probably responsible for the fact that the nerves are rarely injured at the time of the original injury or encroached upon by callus during the period of healing.

2 Treatment of the fracture itself From the standpoint of treatment fractures of the pelvis may be divided into two groups (1) Those in which the position of the fragments is satisfactory, and (2) those in which the position of the fragments is not satisfactory.

In the first group the patients are kept in bed and no specific treatment is indicated. In the second group specific mechanical force is so directed that it will tend to correct definite deformities and to maintain the correction until the fractures have united sufficiently to prevent a recurrence of the deformity. It is thus evident that a fairly accurate diagnosis of the condition of the pelvis is desirable before treatment is instituted and this is best obtained by the x-ray, because, while certain gross deformities may be detected by inspection or palpation, the details of the fracture remain obscure. Consequently, we advise an anteroposterior roentgenogram of the pelvis before deciding on the method of treatment. From this x-ray the given case can immediately be placed in one of the two groups already mentioned.

Gross displacement of large fragments which result in asymmetry of the pelvis demand correction if possible, but minor displacements are not considered to be of sufficient importance to demand specific treatment unless they involve the hip or sacro-iliac joint or symphysis pubis or encroach upon the birth canal in a female patient.

It is to be noted that the classification given does not take into consideration the location, extent, or number of fractures present in the pelvis. As a matter of fact the majority of fractures of the pelvis are multiple (70 per cent in our series),

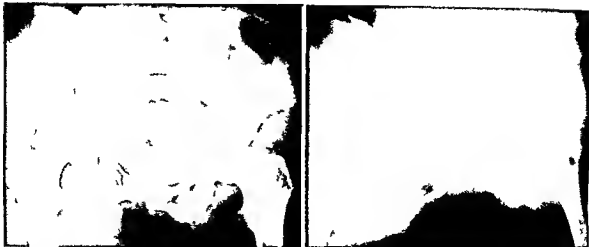


Fig. 1. Left: Malgaigne type of fracture showing hemipelvis and a fracture of the pubis. Right: Roentgenogram of same

patient taken after reduction of the fracture by means of traction in a Hodgen splint.

yet approximately 75 per cent of all pelvic fractures fall into group 1 and require no reduction and no immobilization other than rest in bed. These include not only isolated fractures of the pelvis in which the ring of the pelvis is not broken such as fractures of the wing of the ilium and fractures of a single ramus of the pubis or ischium but also fractures of both ramus of the body of the pubis in which the pelvic ring is broken but in which there is no marked displacement of the fragments. It also includes certain double fractures of the pelvic ring such as the fractures of both ramus on each side of the body of the pubis without displacement of the central fragment and occasional fractures of the Malgaigne type with a complete fracture through the anterior portion of the ring and another fracture through the posterior portion in the vicinity of and roughly parallel to the sacro iliac joint in which the fragments are not displaced.

Why do these fractures require neither reduction nor immobilization? They require no reduction because the fragments are not sufficiently displaced to interfere with union or with function after union occurs. They require no specific immobilization because the displacement when it occurs in pelvic fractures is usually due to the fracturing force rather than to muscle pull and not only has this force ceased to act but by the time the roentgenogram has been taken the patient has been moved to the hospital and subjected to more strain than will result from lying in bed until the fragments have united. Consequently, bed rest is all that is needed in the way of treatment of the fracture but during the first

week or so the pelvis may be quite sore and movements may be very painful. In order to avoid the necessity of lifting or turning the patient he is placed on a fracture bed during this period. Such a bed is fitted with cross straps over the mattress which may be tightened while the mattress is lowered for the use of the bed pan and general nursing care. A pillow is placed under each knee to maintain the lower extremities in a position of moderate flexion. A frame is placed on the bed and a horizontal bar is suspended above and within reach of the patient in order that he may lift his body with his hands and shift his position in bed at will. If the patient is not comfortable traction of from 5 to 10 pounds is placed on each leg. Skin traction by adhesive is sufficient and the rope passes over pulleys at the foot of the bed. In certain instances a strip of adhesive about 6 inches wide is placed around the pelvis but we do not use the adhesive or any other form of binder as frequently or for as long a period as we have in the past because we find that our patients do just as well and are more comfortable without them.

As soon as the fracture is sufficiently healed to permit the patient to use a bed pan without pain (about 2 weeks) he can be moved to an ordinary hospital bed which may have a fracture board placed between the spring and the mattress to prevent sagging. This also should be fitted with a horizontal bar to enable him to move about in bed at will. The patient may be propped up in bed or sit up at will. It is thus evident that the treatment is largely symptomatic and it is believed that the movements or positions which do



Fig. 2 Left Fracture of the acetabulum with partial intrapelvic luxation of the fragments. Right Same after

reduction by traction in a Hodgen splint and manipulation without anesthesia

not cause undue pain will not cause displacement of the fragments or interfere with the healing of the fractures

Depending upon the location, extent, and severity of the fractures, the patient is kept in bed for from 4 to 8 weeks. At the end of this time he is gotten up on crutches and begins to walk with support. In a week or 2 the crutches are discarded and a cane is used until the patient walks comfortably without it.

In fractures in which the fragments are sufficiently displaced to interfere with function, an effort should be made to reduce the displacement and to maintain the reduction. The methods used are traction, lateral pressure or, rarely, manipulation under general or spinal anesthesia.

The types of fractures which require especial attention are (1) Separations at the symphysis or fractures through the anterior ring with spreading or rotation of the ilia, (2) double fractures of the ram on each side with displacement of the middle fragment, (3) the double vertical fractures of Malgaigne with displacement of the lateral fragment, and (4) fractures of the acetabulum.

In separation of the symphysis or fractures through the anterior ring, displacement may occur by rotation of one innominate bone so that its anterior portion is displaced upward and outward or the pelvis may be opened almost directly outward in a manner similar to that in which a clam shell is opened. In these fractures lateral compression of the pelvis is desirable in order to push the two sides of the pelvis together, and also to so rotate the displaced lateral fragment that it will

approach its normal position. We have found that adhesive strapping and swaths cannot be depended upon to accomplish the desired result. In order to obtain continuous lateral pressure on the pelvis the patient is placed in a canvas sling or hammock which passes under the pelvis transversely and the ends of which are suspended by weights equal to about one third of the weight of the patient. The ends of the hammock are close to the midline of the body and it exerts considerable lateral pressure. If it is desired to decrease the amount of lateral pressure, a wooden spreader is placed between the free ends of the sling and the amount of lateral pressure exerted by the sling varies inversely with the width of the spreader (Key and Conwell). At the same time we put traction on one or both legs. If the symphysis is rotated upward on one side, we place more traction on that extremity.

In double fractures through the anterior ring with displacement of the central or pubic fragment we place the patient in a sling for a short time with traction on both lower extremities which are maintained in a position of moderate abduction and extension in an effort to pull the displaced fragment down to its normal position.

In the double vertical fractures of the Malgaigne type in which there is a fracture through the anterior ring and another fracture through or near the sacro-iliac joint there may be a variable amount of displacement of the large lateral fragment which carries the lower extremity with it so that this extremity is actually shortened in its relation to its fellow while its length as measured



Fig. 3 Central fracture of acetabulum with intrapelvic luxation of the head of the femur

from the anterior superior spine of the ilium is not altered. The loose lateral fragment may also be rotated or everted.

The upward displacement is probably caused by the fracturing force, but the muscles which pass upward from the loose lateral fragment to the lumbar spine and lower ribs tend to maintain the displacement and may be a factor in causing it. At any rate the treatment indicated is to pull the loose fragment down to approximately its normal position and to hold it down until union is sufficiently firm to prevent recurrence of the deformity. This can be done by making relatively strong traction on the extremity on the affected side. This has been done by means of a well leg traction splint, but our usual procedure is to place the leg in a Hodgen's splint and pull the extremity downward just as though the



Fig. 5 Final result after treatment in cast (Same case as in Figure 3)

patient had a trochanteric fracture of the femur (Fig. 1). If there is no improvement in the position as shown by the x-ray picture taken at the end of 48 hours of strong traction, it is probable that the fragments are locked in their abnormal relationship and an attempt should be made to manipulate the fragment downward under a general anesthetic while the traction is maintained.

If there is also rotation or eversion of the lateral fragment, it is probable that this will be corrected as the upward displacement is corrected by the traction. However, if the x-ray film which should be taken about 48 hours after the application of the traction shows that there is persistent rotation or eversion of the lateral fragment, it is evident that lateral pressure on the pelvis is indicated and the patient should be placed in a pelvic sling as noted in the preceding paragraphs while the downward traction on the extremity is maintained.

Watson Jones has recently published a method by which these fractures are reduced by placing the patient on a pelvic rest in the lateral position. A double plaster of paris spica is then applied and the patient is maintained in the lateral position in the cast until the fractures have healed. We have not used Jones' method but have obtained satisfactory reduction and healing in our cases by the method described here. The traction is maintained for from 4 to 6 weeks and then after 2 weeks further rest in bed the patient is gotten up on crutches which are discarded as soon as he is strong enough to do without them.

The fractures of the acetabulum fall into three groups: (1) simple fractures of the acetabulum

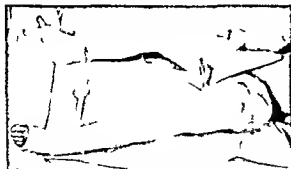


Fig. 4 Illustration of cast with turnbuckle applied to patient with fracture as shown in Figure 3. The dotted lines show the approximate position of the Steinmann pins.



Fig. 6 Left Fracture of the anterior rim of the acetabulum Right Result after open reduction

without displacement, (2) central dislocations at the hip, and (3) fractures of the rim of the acetabulum with or without dislocation at the hip. We believe that joint fractures usually do better if treated in traction, even when there is no appreciable displacement of the fragments. Consequently, these fractures are treated by traction for from 2 to 8 weeks, the period of traction varying directly with the severity of the fracture. If the head is not displaced inward the patient is simply put to bed and about 10 pounds of traction is applied by Buck's extension or the extremity is suspended in a Hodgen's splint which, in the case of an adult, affords from 10 to 20 pounds of traction in a position of slight flexion and moderate abduction. The amount of traction increases as the suspending rope is inclined away from the vertical position.

In the central dislocations at the hip the head of the femur is driven inward fracturing the floor of the acetabulum and pushing the fragments before it into the pelvis. If this fracture is permitted to heal with the head in its abnormal position, a stiff and painful hip is obtained. Consequently, the head should be brought out to its normal position. Usually the displacement of the head is not marked, and a moderate amount of traction (15 to 20 pounds) with the extremity in slight flexion and abduction is sufficient to reduce the dislocation and as the dislocation is reduced the fragments of the floor of the acetabulum tend to follow it and fall back into their normal positions (Fig. 2).

It is to be noted that we do not advocate placing the finger in the rectum and attempting to push the fragments of the floor of the acetabulum

outward into their normal position, as is advocated by Boehler. This is because we fear that a sharp fragment might be pushed through the wall of the rectum and cause an infection, and also because we have found it not to be necessary if one will only apply traction and wait a few days after the dislocation is reduced before deciding on the—to us—rather dangerous procedure.

Occasionally the head is driven far into the pelvis and locked there by fragments or margins of the defect which encroach upon the narrow neck behind the relatively large head and traction in line with the shaft of the femur will not dislodge it. In such instances we try to pull the head out by manual traction in bed without an anesthetic. If this is not successful the patient is given a general anesthetic and traction is made in line with the shaft of the femur with the extremity in a position of slight abduction, and also traction is made directly outward on the upper thigh, thus, the resultant of the two forces is a pull outward and downward roughly in line with the neck of the femur. Occasionally, in resistant cases, we have manipulated the extremity into abduction or adduction while the traction was maintained.

We have seen only one patient in whom it was not possible by manipulation alone to dislodge the head from the pelvis. This was quite an old man with a marked displacement, as illustrated in Figure 3. In this particular instance metal pins were placed through the trochanteric region of each femur passing from before backward and incorporated in plaster of Paris casts. The casts extended to the toes where the two feet were fastened together and a turnbuckle was placed between the legs in the region of the upper thigh

As the turnbuckle was spread the trochanters were pulled apart and thus the head of the femur was gradually pulled out of the pelvis into its normal position (Figs 4 and 5). Unfortunately this patient died of pneumonia about a month later.

In all there were 15 patients with fracture of the acetabulum and central dislocation at the hip in this series who were treated by the methods here described. It has been possible for us to trace 6 of these and all of them except one returned to their original occupations without appreciable disability. The exception walked with a slight limp, had moderate limitation of movement at the hip and complained of some pain, but was able to do her housework and climb stairs without difficulty.

The third group of fractures of the acetabulum comprises those cases in which a significant fragment of the rim is broken off and displaced. There was only one such fracture in our series and in this instance the hip was not dislocated. In our case the loose fragment was exposed through an anterior incision and after reduction was fixed with chromic catgut sutures and the hip was immobilized in a plaster of paris spica cast for 6 weeks. An apparently normal hip was obtained (Fig. 6). Where this fracture complicates a dislocation at the hip the dislocation should be reduced and then if the fragment is not in a satisfactory position it should be replaced and fixed by open operation.

CONCLUSIONS

In a series of 184 consecutive fractures of the pelvis we have found that 70 per cent were multiple fractures and also that over 75 per cent were simple fractures without important displacement of the fragments.

With simple fractures without important displacement whether they be multiple or single fractures the patients appear to be more comfortable, recover more rapidly and obtain satisfactory results if they are treated by permitting

them to be in bed in a comfortable position until the sensitiveness disappears after which time they may move about in bed at will.

In fractures with important displacement of the fragments an attempt should be made to obtain a good functional reduction.

In pelvic fractures with complications the complications usually demand immediate treatment and the fracture of the pelvis may be allowed to wait until the complications are taken care of.

REFERENCES

1. BOSHLER, LORENZ. The Treatment of Fractures. 4th Eng. ed. translated from the 4th en. and rev. German ed. by Ernest W. Hey Groves. Baltimore: William Wood & Co. 1935.
2. CARRETHERS, F. W. Anatomical and functional results in fractures of the pelvis. *South M. J.* 1934 37: 454-455.
3. CONWAY, M. Fractures of the pelvis. *Am. J. Surg.* 1935 30: 69.
4. JARVIS, S. J. Injuries involving the ilium. A new treatment. *J. Bone & Joint Surg.* 1935 17: 338-346.
5. JONES, K. W. Fractures and fracture dislocations of the pelvis. *Brit. J. Surg.* 1938 25: 773.
6. KRY, J. A. and CONWELL, H. E. Fractures, Dislocations and Sprains. St. Louis: The C. V. Mosby Co. 1937.
7. KOSTER, H. and KASMAN, I. P. Treatment of fractures of the pelvis. *J. Bone & Joint Surg.* 1937 19: 1130.
8. LAW, C. R. Nerve injury in fractures of the pelvis. *Ann. Surg.* 1936 104: 945.
9. LINGG, A. J. The use of the Jones splint in the treatment of fractures of the pelvis and of the neck of the femur. Series of 40 cases. *J. Bone & Joint Surg.* 1935 17: 433.
10. LINDRETT, G. W. Fractures of the pelvis. *South M. J.* 1933 25: 742.
11. McBRIDE, L. D. The overslung traction saddle frame. *Ann. Surg.* 1933 97: 309.
12. NOLAN, LLOYD and CONWELL, H. F. Acute fractures of the pelvis: treatment and results in one hundred and twenty five cases. *J. Am. M. Ass.* 1930 94: 174-178.
13. STEIN, W. C. Fracture dislocations of the ilium treated by well leg traction splint. *Am. J. Surg.* 1936 33: 179.
14. WAXLEY, C. P. Fractures of the pelvis: analysis of 100 cases. *Brit. J. Surg.* 1929 17: 22-29.

AUTOPLASTIC FASCIA SUTURES IN REPAIR OF INGUINAL HERNIA

LOUIS SACHS, M D, F A C S, Baltimore, Maryland

IN 1904 McArthur reported a series of cases of inguinal hernia repair, using aponeurosis of external oblique as suture material. Supported by experimental work, he maintained that the method of closure was not as important as the suture material. These sutures, one obtained from each free edge of the incised aponeurosis, were fixed medially at the pubis and the midline. The free ends were attached to silk threads, which in turn were threaded through needles. The suture derived from the upper flap was used to unite the conjoined tendon and the internal oblique muscles to Poupart's ligament. The suture from the lower flap united both flaps of the aponeurosis.

In 1916 and 1917 Lewis and his associates, reporting experimental and clinical work, showed conclusively that autotransplants of fascia and tendon would continue to live and that they would retain their own gross and histological characters.

In 1921 Gallie and LeMesurier repeated this work of Lewis, arriving at the same conclusions. They called attention to the fact that there was no evidence of proliferation of the essential cells of the transplanted tissue. They claimed that union or healing occurs not from tendon or fascia cells, but from connective tissue cells and therefore forms a true scar, therefore, the necessity of the removal of all areolar tissue attached to the fascia or tendon sheath. Furthermore, scar tissue has a tendency to stretch. Therefore transplants are to be attached not end to end, but by broad apposition or application of transplant to the surrounding tissue. Gallie and LeMesurier recommended the use of fascia lata. The disadvantage of this method of procedure is that the source of fascia lata is somewhat distant from the site of operation.

This work was followed by others, notably Koontz, who experimented with and popularized, the use of ox fascia in the repair of inguinal and ventral hernia. Koontz claimed the following advantages of this method: (1) ox fascia can easily be obtained, prepared, preserved in tubes, and kept in stock to be used when needed, (2) although a heteroplastic graft, ox fascia is no different than fascia lata, since it depends for its strength on the

collagen fibers which are inert and act as frame work for fibroblasts to mature and form scar tissue. The serious disadvantage of the method, however, is the difficulty of removing all the foreign material from the fascia. This results in atypical postoperative febrile courses, associated often with more or less prolonged drainage from the wounds with or without infection.

The author has modified McArthur's procedure incorporating principles advanced by the authors quoted, to obtain the maximum strength in hernial repair. This method can be adapted to any well recognized operation. For illustrative purposes the author has selected the so called Halsted procedure.

After the usual preparation of skin an inguinal incision is made, exposing the aponeurosis of the external oblique. The upper surface of the aponeurosis is then stripped of its areolar connective tissue and is incised in the direction of its fibers from the edge of its muscular portion down to the middle of the external ring. It is best not to complete the division of the external ring until the next two incisions, parallel to it, are completed. These are made 6 to 7 millimeters above and below, beginning at the muscular edge of the aponeurosis and extending to its insertion medially, the upper into the midline in association with the

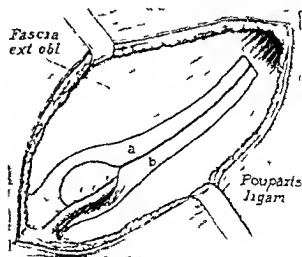


Fig 1 Formation of autoplasmic fascial sutures. *a* strip derived from the upper flap of the external oblique *b* strip derived from the lower flap

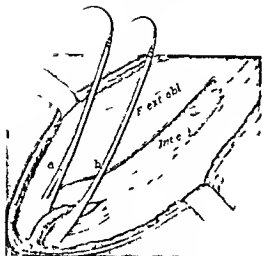


Fig 2 Fascial sutures attached to needles

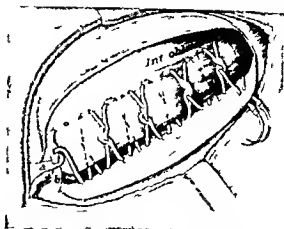


Fig 3 Diagrammatic representation of the passage of fascial sutures through the internal oblique, the conjoint tendon and Poupart's ligament and the mutual transfixion of these sutures

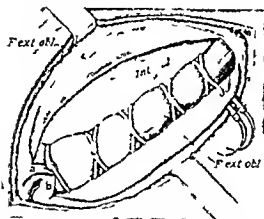


Fig 4 The fascial sutures approximate the internal oblique and conjoint tendon to Poupart's ligament. The reconstruction of the pillars of the external ring is obvious

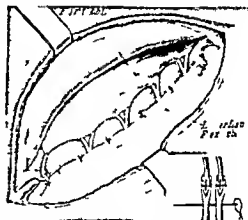


Fig 5 The overlapping of the lower flap of the aponeurosis is shown

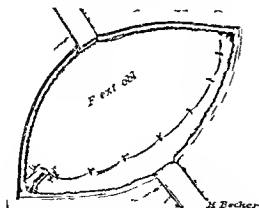


Fig 6 The overlapping of the upper flap of the aponeurosis over the upper surface of the lower flap is shown

rectus fascia and the lower into the pubic bone. The strips of fascia (Fig 2 a and b) thus patterned are divided at their junction with the muscular portion of the external oblique. They are then stripped from the underlying areolar tissue down to their insertions and are ready to be used (Fig 3). A transfixion suture is placed through the free end of each strip and the strips are then attached to Ferguson (medium) needles, as indicated in Figure 2 a and b. The conjoint tendon, internal oblique and Poupart's are then exposed and freed from areolar tissue. The sac is dealt with in appropriate manner.

The fascial sutures a and b are made to transfix each other as shown in Figure 3. The lower fascial suture b is then passed through the conjoint tendon from its anterior surface toward the poste-

rior and then upward through Poupart's ligament close to the pubic spine, shown in Figure 3. The upper of the fascial sutures, *a*, is passed through Poupart's in a direction opposite to the usual, toward its lower edge. After emerging from the lower edge of Poupart's ligament, it is passed in an anterior direction through the conjoined tendon as shown in Figure 3. The fascial sutures are drawn taut and made to transfix each other. The procedure just described is repeated, the thread, *b*, which has just emerged from Poupart's ligament, always enters the anterior surface of conjoined tendon, goes in a posterior direction, and then again passes through Poupart's ligament in the usual manner. The upper suture, *a*, the one emerging from upper surface of conjoined tendon, enters Poupart's ligament in reverse of the usual manner, then emerges from the lower edge and enters the internal oblique from its posterior aspect to emerge again anteriorly, then transfixes the other suture, *b*, and is in turn transfixed by it (Figs 3 and 4). The average fascial strand is ample in length to make four complete sutures with ease. At the end both sutures are brought through the lower flap of the external oblique.

The lower flap of aponeurosis is then tacked to the upper surface of the internal oblique and conjoined tendon without tension, by interrupted black silk sutures (Fig 5). The needles are then cut from the fascial strips. The stumps of the strips sewed to each other are sutured to the upper surface of the lower flap of aponeurosis. The upper flap is then tacked, without tension, to the upper surface of lower flap and to Poupart's ligament with fine black silk sutures, interrupted (Fig 6). Scarpa's fascia and skin are closed in the usual manner.

This method's claim to existence is that it adds to McArthur's method the principles enunciated by Dean D. Lewis and his associates and Gallie and LeMesurier. The stripping of the overlying and underlying areolar tissue from the aponeurosis is emphasized. The simultaneous use of two sutures passing in opposite direction causes a broad approximation of the surfaces and leads to greater security. The double transfixion of sutures prevents slipping, thereby adding strength. This double transfixion together with the fixation of the sutures at the pubic spine reconstructs the pillars of the external ring thus causing the latter to fit snugly around the emerging cord without constriction.

BIBLIOGRAPHY

- 1 DAVIS J D The transplantation of free flaps of fascia Johns Hopkins Hosp Bull 1911 22 372
- 2 GALLIE W E and LEMESURIER A B The use of living sutures in operative surgery Canadian M Ass J 1921, 11 504-513
- 3 Idem A clinical and experimental study of the free transplantation of fascia and tendon J Bone & Joint Surg 1922 4 600-612
- 4 Idem Living sutures in the treatment of hernia Canadian M Ass J 1923 13 469-480
- 5 Idem The use of free transplants of fascia as living sutures in the treatment of hernia Arch Surg 1924 9 516-529
- 6 Idem The transplantation of the fibrous tissues in the repair of abdominal defects Brit J Surg 1924 12 289-320
- 7 Idem Late results of living suture operations in ventral and inguinal hernia Canadian M Ass J 1930 23 165-168
- 8 HALSTED W S The radical cure of hernia Johns Hopkins Hosp Bull 1889 1 12-13
- 9 HORSELEY G W Behavior of alcohol preserved fascia lata of ov. autogenous fascia and kangaroo tendon in dog and man Ann Surg 1931 94 410
- 10 KOONZ A R Muscle and fascia suture to hernia repair Surg Gynec & Obst 1926 42 222
- 11 Idem Experimental results with dead fascia grafts for hernia repair Ann Surg 1926 83 523-536
- 12 Idem Dead (preserved) fascia grafts for hernia repair J Am M Ass 1927 89 1230-1234
- 13 Idem Suture material for hernia repair with special reference to preserved fascia strips South M J 1932 25 372
- 14 Idem Preserved fascia in hernia repair Arch Surg 1933 26 500-509
- 15 LEWIS DEAN D and DAVIS C B Experimental direct transplantation of tendon and fascia J Am M Ass 1911 57 540
- 16 Idem Experimental direct transplantation of tendon and fascia J Am M Ass 1911 57 540
- 17 Idem Repair of tendons by fascial transplantation J Am M Ass 1914 62 602
- 18 LEWIS DEAN D Transplantation of fascia and tendon Lancet Clin 1916 115 300
- 19 Idem Fascia and fat transplantation Surg Gynec & Obst 1917 24 127
- 20 MALL F P On the development of the connective tissues from the connective tissue syncytium Am J Anat 1902 1 329-365
- 21 MEYER LEO The physiological method of tendon transplantation Surg Gynec & Obst 1916 22 128
- 22 MCARTHUR LEWIS L Autoplastic suture in hernia and other diseases preliminary report J Am M Ass 1901, 37 1162-1164
- 23 Idem Autoplastic suture in hernia and other diseases J Am M Ass 1904 43 1039-1048
- 24 ROSENBLATT M S and COOKSEY W B Muscle fascia suture in hernia Ann Surg 1927 86 71-77
- 25 ROSENBLATT M S and MEYERS M Muscle fascia suture with preserved fascia and tendon Surg, Gynec & Obst 1928 47 836

COMPLETE LACERATIONS OF THE PERINEUM

An Analysis of 205 Surgical Repairs

RUPERT F. ARNOLD, M.D., I.A.C.S. and JULIAN J. FERTITTA, A.B., M.D.
New Orleans, Louisiana

DESCRPTIONS of an effective surgical cure still comprise a large part of the literature of complete lacerations of the perineum. Studying the reports however, one is chiefly impressed by the fact that there is a noticeable lack of agreement as to the technique which gives the best results. So far as we have been able to discover, no large series of cases is on record in which a single method was employed by many individual surgeons. It is with the idea of recording such a series that we are reporting herewith 205 complete lacerations of the perineum treated at Charity Hospital of Louisiana in New Orleans during the 10 year period ending June 20, 1938. The series does not include any acute tears.

ANALYSIS OF DATA

Rate and age. Thirty-four of the 205 patients were colored and 171 white, giving a ratio of 1:5. During the same period the ratio of hospital admissions was roughly 4:3, and three fifths of the number of registered births in this area were white. Our figures therefore corroborate the conclusions of C. J. Miller, W. E. Levy, and others whose comparative studies of white and negro women reveal a relatively small percentage of perineal injury during delivery in negro women. The age range in this series was from 8 to 56 years.

Etiological factors. In 2 patients parturition was not a factor. One complete perineal tear occurred in an 8 year old colored child following rape and the other also in a child was produced by a fall on a picket fence. About two thirds (133) of the remaining patients were primiparae.

Complete perineal lacerations may occur in the practice of even a competent obstetrician and generalizations are not entirely wise. On the other hand, there is no doubt that they are usually associated with poor obstetrics. An analysis of these cases justifies the statement that a third degree tear is nearly always preventable if com-

petent medical attention is provided. Hospitalization for all primiparae as well as for all abnormal multiparae is also highly desirable.

Approximately half (104) of the women in this series were attended by midwives at delivery, a number entirely out of correspondence with the fact that during the same period only 20 per cent of the total number of deliveries in the community were conducted by midwives. Of the 101 cases conducted by physicians, 48 approximately one half were operative deliveries and usually difficult ones. It is significant under the circumstances that only 9 of the 205 women, 4 per cent, were delivered in a hospital where the proper facilities, essential equipment, and trained personnel were available.

The incidence of third degree lacerations among negro women, as we have already pointed out, is very much lower than in white women. There is an even more striking difference in the racial incidence in relation to the mode of delivery. Twenty-six of the negro women, 76 per cent, were delivered by operative methods, against only 2, 13 per cent, of the white women. It is therefore reasonable to assume that when a tear occurs in a colored woman it is usually the result of operative trauma, whereas white women frequently suffer complete perineal tears during natural parturition. Third degree lacerations occurred typically during spontaneous delivery in primiparae but usually followed operative intervention in multiparae.

Previous attempts at repair. Repair had been previously attempted in 47 patients who had been submitted to a total of 73 operations ranging in number from one attempt in 14 cases to 6 in 1 case. Eighteen of the repairs were attempted immediately after the injury occurred and it is a significant fact from the standpoint of the occurrence of the injury as well as the failure of the attempted repair that only three of the women had been delivered in hospitals. In 29 cases the previous secondary operation had been successful but the tear recurred in a subsequent delivery. It is again significant that in only 7 of these 21 cases was the subsequent delivery conducted in a hospital.

From the Department of Obstetrics and Gynecology of the School of Medicine of Louisiana State University and the Gynecological Services of Charity Hospital of Louisiana at New Orleans.
Read before the New Orleans Gynecological and Obstetrical Society, December 16, 1938.

The recurrence of the tear in a future delivery is a disheartening possibility, but one which is by no means inevitable, as our own experience shows. In most instances the damage can be prevented if the proper precautions are taken. The patient should be cared for in hospital, deep episiotomy, sometimes bilateral, should be employed, and the whole delivery should be conducted with extreme care and gentleness. Cesarean section should be seriously considered if the child is large and the perineum is excessively scarred and rigid, or if the patient desires sterilization.

Findings and symptomatology. Although a consideration of the mechanism by which complete tears occur is not part of this report it must be noted that the results in precipitate deliveries, in difficult natural deliveries, and in badly managed operative deliveries are practically the same. In all the cases in this series the external and internal sphincter ani muscles were completely severed. In most instances the levators were also ruptured or badly stretched, which is an important consideration. If these muscles are undamaged, bowel control is still possible, even when the sphincter ani has been destroyed. In 168 cases, 82 per cent, the anterior rectal wall was torn and required suture, and in 113 cases, 55 per cent, the laceration extended up the bowel wall for a distance of at least 3 centimeters. In other words, in well over half the cases the complete laceration of the perineum was complicated by a serious involvement of the rectal wall, which greatly increased the difficulties of surgical repair. Definite coexistent rectoceles were present in about a third of the cases, which is another important consideration, for failure to recognize and correct a rectocele or an enterocele is often responsible for unsatisfactory surgical results.

The average duration of the injury prior to correction was 6.6 years, and 1 patient had actually allowed it to continue for 41 years. These figures are not surprising in view of the generally low level of intelligence likely to be exhibited by patients who are public charges. Such women will endure for long periods of time conditions which private patients would not tolerate under any circumstances.

The entire group complained of incontinence of feces. All lacked control of liquid stools and gas, though some 25 per cent had partial control of formed stools, especially when a natural tendency to constipation existed, or when a constipating diet had been deliberately chosen. Unsatisfactory sexual relations was often a major complaint, and there was a high incidence of melanocholia, unnatural introspection, and pronounced

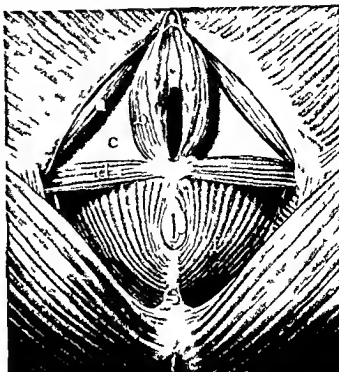


Fig 1. Anatomy of the pelvic floor. *a* ischio cavernosus muscle. *b* bulbocavernosus muscle. *c* endopelvic fascia. *d* transversus perinei muscle (superficial and deep). *e* sphincter ani muscles (internal and external). *f* levator ani musculofascial sling. Note the decussation of fibers and the attachment of the sling to the perineal body. It is this anatomical arrangement which permits the sling to exert an effective sphincteric action on the rectum.

sense of inferiority. Such patients frequently isolate themselves from all social contacts and brood continuously.

SURGICAL REPAIR

The necessity for the surgical correction of complete perineal repairs need not be discussed. There is no other method of treatment because there is no tendency in such cases toward spontaneous healing. Surgery, furthermore, should not be unduly delayed, because the constant irritation produced by the unhygienic condition of the tissues aggravates the original lesion. Another consideration, which is rarely emphasized, is that perineal lacerations tend to be aggravated by the natural changes of advancing age. Several of the patients in this series contributed the unsolicited information that their symptoms had become more troublesome during the time of the menopause period.

The therapy of complete perineal lacerations falls naturally into three separate divisions, preoperative treatment, operative technique, and postoperative care, and all are of the utmost importance.

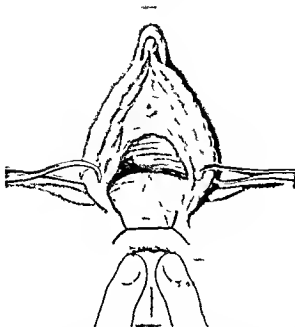


Fig 2 Complete laceration of the perineum without involvement of the rectal wall. Note the dimples which represent the retracted ends of the torn atrophic sphincter ani. The shortened muscle is stretched manually so that it encircles the anal opening completely and without undue tension. The line of preliminary incision is shown. Particular care must be taken to excise all scar and granulation tissue.

Pre operative treatment. Preparation for operation consists merely in the use of a low residue diet for 3 or 4 days before operation and the use of soap-sud enemas the night before and the morning of operation both repeated until the solution returns clear. Violent and repeated catharsis not only annoys and weakens the patient but also may prove actually harmful by producing local intestinal irritation.

Technique. All of the lesions in this series were repaired by the same method: a variation of the technique originally described by Emmet and Hegar and modified by Clark and Miller of New Orleans. No one of the 41 surgeons represented in the 205 cases operated on more than 13 patients.

General anesthesia was used in 133 cases or 55 per cent; spinal analgesia in 82 or 40 per cent; parasacral analgesia in 6 or 3 per cent; and local analgesia in 4 or 2 per cent. The average duration of the operation was 47 minutes.

The successive steps of the operation (Figures 2 to 7) include the incision, the complete excision of all scar and granulation tissue, separation of the rectal and vaginal walls, isolation of the torn

sphincter ends, closure of the rectal tear, approximation of the sphincter ends, approximation of the perirectal tissues, repair of the levator ani musculofascial sling overlying the rectum, conclusion of the perineorrhaphy, Colporrhaphy, plication of the rectum, and other additions and variations are introduced according to the indications of the individual case.

Even more than is true of other surgical procedures, the successful repair of obstetric injuries is based upon a detailed knowledge of the regional anatomy (Fig 1). The observance of certain fundamental surgical principles and certain technical details is also important. These include:

1. The relation of the time of repair to parturition. If the patient has been delivered in hospital, excellent results may be anticipated following immediate repair of fresh lacerations. Equally good results are likely to follow primary or secondary repair of old lacerations at subsequent deliveries. If however the repair is not done immediately after delivery, or if the primary repair has not been successful, further attempts should be deferred for at least 6 months. Such a delay will permit proper involution of the parts and the second operation will not be complicated.

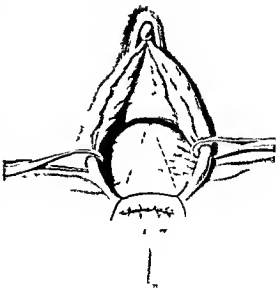


Fig 3 Complete laceration of the perineum with concurrent rectocele. Line of incision shown. When this complication exists it is imperative that high colporrhaphy and plication of the rectum be added to the usual perineorrhaphy and approximation of the severed ends of the sphincter ani muscle.

by excessive hemorrhage, extreme friability of the tissues, or postoperative infection

2 An exceedingly careful aseptic and antiseptic technique. Because the surgeon must work in an area which is never free from contamination, unusual precaution is necessary to prevent the development of infection

3 The complete excision of all cicatricial tissue, and the removal or freshening of granulation tissue, because healing does not occur readily in tissues in which the blood supply is inadequate

4 A careful reconstruction of the torn parts, on an anatomical basis, to facilitate primary healing

5 Approximation of tissues without devitalization. Freedom from tension is imperative. The sutures must be very carefully placed, they must not be tied too tightly, and large masses of tissue must not be included within them

6 Restriction of the surgical procedure to the repair of the perineal tear, no matter how strong is the temptation to perform other necessary surgery, particularly abdominal surgery, at the same time

Postoperative treatment Postoperative treatment is directed toward two ends, the prevention of infection and the elimination of strain on the

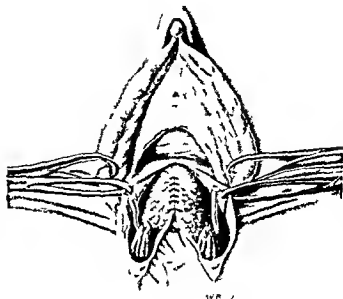


Fig 5 The rectal and vaginal walls are separated by a combination of sharp and blunt dissection. Thorough denudation of the perineum is essential. The ends of the torn sphincter and muscle are isolated and grasped with Sheppard hook preliminary to approximation with interrupted 40 day No. 1 chromic catgut sutures. The tear in the rectal mucosa is closed with interrupted No. 2 linen sutures and the knots are tied within the bowel lumen

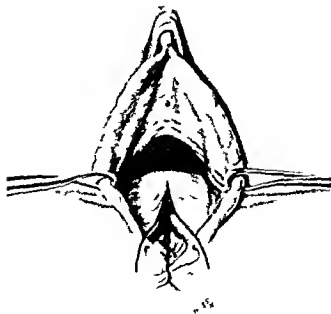


Fig 4 Complete laceration of the perineum with tear of the anterior rectal wall. The line of incision extends downward over the sphincter pits affording good exposure and easy access to the ends of the torn sphincter and the rectal canal and the levator ani muscles

newly repaired tissues. Infection is guarded against by ordinary cleanliness and by routine perineal care after each defecation and urination. The parts are irrigated externally with warm saline solution and dried lightly with sterile gauze, after which the operative site is painted with 5 per cent mercurchrome solution. Neither vulvar nor perineal pads are used in this operation

In order to prevent all tension on the suture line from movements of the body, the legs are fastened together until the patient recovers from the anesthesia, and the restraint is continued if she is uncooperative or unduly restless. In the average case the first defecation is postponed for a week after operation, although some authorities consider this precaution unnecessary and advise the free use of mineral oil within 1 or 2 days. This plan is apparently without ill effects, for certain patients in this series who had spontaneous bowel movements within 36 hours apparently progressed as well as the patients whose bowels were kept locked

Our postoperative routine includes the following measures

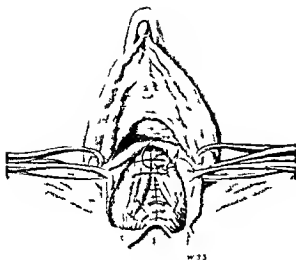


Fig 6. The perirectal tissues are approximated by means of plain No. 2 catgut sutures. The levator ani musculofascial sling overlying the rectum is carefully repaired. It has been emphasized that properly reconstructed levator ani muscles can produce satisfactory bowel control even in the absence of sphincter ani fibers. Note the reinforcement sutures uniting the sphincter ani and levator ani muscles. The tissues are approximated without undue tension; dead space is obliterated and absolute hemostasis secured.

1. A liquid diet for 7 days which permits broths, gruels, and fruit juices but not milk. Soft diet is ordered for the next 7 days and then the usual diet is resumed.

2. Opium pills (gr. τ) or paregoric (3 τ) three times a day for 5 days.

3. Mineral oil (3 τ) three times a day after the fifth day.

4. Epsom salts or citrate of magnesium as necessary after the sixth day.

Enemas and rectal irrigations are not permitted and defecations are produced solely by the use of laxatives. Immediately after operation the local application of an ice cap wrapped in a sterile towel adds to the patient's comfort and prevents the development of edema. Later dry heat is used to promote and stimulate healing. Hospitalization for at least 14 days is always required and a longer stay is frequently advisable.

RESULTS

There were no deaths in this series. Infection was responsible for the immediate failure of 6 operations, in all of which the suture line broke

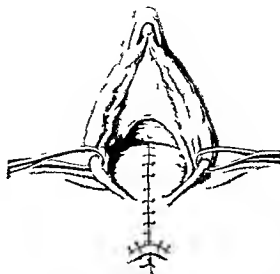


Fig 7. The perineal body is restored in the usual manner. A core tent rectocele should be repaired. The anus is anchored to the skin margin with interrupted 40-day No. 1 chromic catgut sutures. A vaseline pack is placed in the vagina to remain for 48 hours and a retention catheter is inserted into the bladder.

down completely. Milder infection usually of the stitch abscess variety occurred in 26 other cases but usually left no ill effects. Eight patients developed rectovaginal fistulae but surgical correction was required in only two cases all of the others closing spontaneously.

Most of the anatomic results were excellent when the patients were discharged from the hospital or from the follow-up clinic. From the standpoint of function 88.3 per cent of the patients were classed as cured at this time, 7.3 per cent as improved, and 4.4 per cent as unimproved. The evaluation of the results both at this time and later was critical and conservative. The criterion of cure was the complete restoration of sphincteric function and the classification was reserved for patients who had complete control over both feces and gas. The classification function improved was applied to patients who had satisfactory control of formed stools but imperfect control of liquid stools or gas. Many patients in this group considered themselves cured. The classification of unimproved or failure signifies that little or no improvement in sphincter function followed the operation.

A follow-up questionnaire sent to all the 203 patients in the series produced 108 replies. Follow-

up inquiries of this sort are generally admitted to be unsatisfactory, but in this particular condition, because of the character of the symptom complex, the patient's opinion of her condition really furnishes more information than does direct inspection of the operative result. The follow up was accomplished at intervals varying from 6 months to 9 years, and the high percentage of late cures, 81.5 per cent, and the small percentage of failures, 6.5 per cent, are very gratifying.

A certain number of patients who on their discharge from the hospital exhibited little or no benefit from operation later reported practically perfect end results. In 2 such cases satisfactory bowel control was not attained for 6 months. On the other hand, the importance of a late follow up is demonstrated by the fact that several patients who on discharge were classified as cured and who had sphincteric control for longer or shorter periods of time later had a recurrence of symptoms. It is significant that all these patients were elderly women and our own opinion is that such failures might reasonably be charged to the senile changes which occur in pelvic tissues as age advances.

A most interesting feature of our follow up concerns the subsequent obstetric history of 39 patients. Nineteen of them were operated on by us and later delivered by us. All the deliveries were conducted in the hospital, under continuous observation. One patient was subjected to cesarean section, and 17 were handled by deep episiotomy. In only 1 case did the perineal injury recur. There was a recurrence of the tear, however, in the 21 other cases in this group, in only 7 of which the delivery was conducted in the hospital and in none of which special precautions seem to have been taken to guard against a recurrence of the damage. These comparative results bear out the point we have previously made, that recurrence of the laceration is unlikely if proper precautions are taken in subsequent deliveries.

SUMMARY

1. A study has been made of 205 consecutive operations for complete laceration of the perineum, all of which were performed by the same technique.

2. The analysis includes race incidence etiological factors, symptomatology physical findings and previous attempts at repair.

3. The immediate and late results of operation are reported, as is the subsequent obstetrical history of 39 patients.

4. A simple and effective method of repair is described, which was productive of almost uniformly good results in the hands of the 41 surgeons who performed the 205 operations. Underlying principles and points in technique are discussed.

BIBLIOGRAPHY

1. CROSSEN, H. S. and CROSSEN, R. J. *Operative Gynecology*. St. Louis: C. V. Mosby Co. 1938.
2. CURTIS, A. H. *Textbook of Gynecology*. Philadelphia: W. B. Saunders Co. 1938.
3. EMMETT, T. A. Laceration of the perineum involving sphincter ani with operation for securing union of the muscles. *Med Rec* 1892: 8: 121.
4. Idem. A study of etiology of perineal laceration with a new method for its proper repair. *Tr. Am. Gynec. Soc.* 1893: 8: 195.
5. FARRAR, L. K. P. Warren apron in repair of high laceration of rectum associated with third degree laceration of pelvic floor. *Surg. Gynec. & Obst.* 1939: 51: 741.
6. LEVY, W. E. Clinical information based on 1,000 consecutive obstetrical cases. *South. M. J.* 1926: 19: 886.
7. MILLER, C. J. Comparative study of certain gynecologic and obstetric conditions as exhibited in the colored and white races. *Am. J. Obst. & Gynec.* 1928: 16: 662.
8. MILLER, N. F. and BROWN, W. Surgical treatment of complete perineal tears in female. *Am. J. Obst. & Gynec.* 1931: 34: 196.
9. NOBLE, G. H. A new operation for complete laceration of the perineum designed for the purpose of eliminating danger of infection from the rectum. *Tr. Am. Gynec. Soc.* 1902: 27: 357.
10. PHANEUF, L. E. Complete lacerations of perineum and their surgical treatment. *Am. J. Obst. & Gynec.* 1929: 17: 475.
11. PLASS, E. D. Post partum care. *Bull. Johns Hopkins Hosp.* 1916: 27: 107.
12. ROYSTON, G. D. Repair of complete perineal laceration. *Am. J. Obst. & Gynec.* 1930: 19: 185.
13. SMITH, G. V. and LINTON, J. R. Complete laceration of perineum: report of 291 cases seen between 1876 and 1928 at Free Hospital for Women, Brookline. *Mass. Surg. Gynec. & Obst.* 1929: 49: 702.
14. TAIT, L. *Diseases of Women*. Philadelphia: Lea Bros. & Co. 1889.
15. WARD, G. G. Operative technique for repair of rectocele and injury to pelvic floor. *Surg. Gynec. & Obst.* 1929: 48: 399.
16. Idem. *Obstetrics and Gynecology*. Edited by A. H. Curtis. Philadelphia: W. B. Saunders. 1933.
17. WARREN, J. C. A new method of operation for the relief of rupture of the perineum through the sphincter and rectum. *Tr. Am. Gynec. Soc.* 1883: 7: 322.

THE MANAGEMENT OF PATHOLOGICAL FRACTURES

EDGAR M BICK MD FACS New York New York

A REVIEW of the literature on pathological fractures reveals a scarcity of case reports dealing specifically with the effect of treatment on their rate of healing. A number of valuable reports describing individual cases or groups of related cases are extant and several excellent comprehensive papers have been published in which are listed the diseases and abnormalities in which such fractures are known to occur and which discuss in general the prognosis of the more common abnormalities. But the problem of treatment and its end results has almost been disregarded.

This investigation is based upon a study of 83 pathological fractures in 59 cases for which sufficient relevant data were available to warrant conclusions concerning the effect of treatment. In addition specific case reports of fractures occurring in lesions not represented in this collection or represented only by isolated instances were consulted for comparison. The conclusions arrived at enable one to establish certain fundamental principles in the treatment of pathological fractures in general which it is hoped will be of use in the general management of these cases.

ANALYSIS OF CASES

1. *Fragilitas ossium including osteogenesis imperfecta osteopetrosis brittle bones and blue sclerae* (28 fractures 7 cases). These fractures all healed rapidly, often with exuberant callus after simple immobilization or traction. However they remained as weak at the fracture site as was the prefactured bone and were therefore subject to refracture. Most of the deformities were due to malposition of the united fractures.

Treatment. In these patients treatment is best carried on by traction, plaster or splint immobilization. Because of the very young age of many such patients control of the fragments is difficult and may require considerable ingenuity. However if attended with meticulous care many of the deformities so common in these cases in later life can be avoided. The patients should be guarded against falls or other injuries up to the age of puberty. It is noteworthy though as yet inexplorable

From the Orthopedic Service (Dr. S. Kleberg) Hospital for Joint Diseases and the Orthopedic Service The Mt. Sinai Hospital.

Presented before the Orthopedic Section of the New York Academy of Medicine, October 21, 1938.

able that the tendency to fracture is less and as a corollary the strength of repair considerably greater after puberty. Kaplan has noted this fact in a fully observed family group in which fractures ceased with the normal onset of menstruation in the female members.

2. *Carcinoma (melanotic)*. Four of 12 patients lived and were treated 2 to 4 months after fracture and 5 more were known to have lived more than a month. None showed any deposition of callus or other evidence of union. However histological evidence for the existence of some degree of reparative osteogenesis has been presented in such cases and instances in which clinical union has occurred can be found in Eliason, Welch, Handley and Hummel. In none of these authors' cases was there evidence presented of true osseous healing. Handley states that clinically healing occurred with or without radiation. In only one of the present series was radiotherapy exhibited.

Treatment. Simple immobilization in plaster or traction, depending upon the type and location of the fracture is the indicated treatment. In a limited number of cases clinical or fibrous union takes place and the patient is rehabilitated during the remaining life span. Healing is considerably retarded and therefore in successful cases the part requires brace or plaster protection for many weeks or even months. Radiotherapy applied locally has relieved pain in carcinomatous metastases to bone. Hence its use as a palliative measure is indicated regardless of any possible effectiveness in accelerating healing. An interesting case of a pathological fracture of the tibia near the ankle was described by Rassiour in 1921. This was due to a primary carcinoma of the skin at that area which eroded and invaded the adjacent bone. The ulcerated skin had been under local treatment when the bone fractured almost spontaneously. The leg was immediately amputated. This treatment is obviously indicated by the pathological lesion even without fracture.

3. *Bone cyst (7 cases)*. In a metacarpal the fracture healed in normal time and showed considerable replacement of bone when last seen. In the humerus of a boy 6 years of age the fracture healed in 4 weeks and the cyst was filled almost completely by bone 3 months later following treatment by simple immobilization. In the fibula of another patient a fractured cyst healed in nor-



Fig. 1. a left Giant cell tumor fracture b Giant cell tumor fracture healed

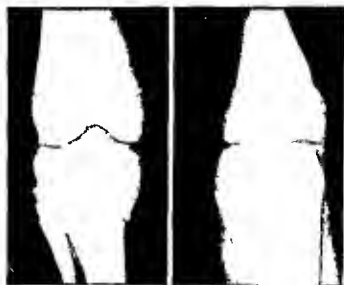


Fig. 2. a left Gaucher's disease fracture b Gaucher's disease fracture healed

mal time following immobilization, but the cyst itself remained unchanged 1½ years after fracture. Curettage and the placing of bone chips within the cavity at that time caused rapid regeneration of bone. In 3 other patients in whom curettage and bone chips were used healing and bone regeneration within the cyst followed rapidly.

Treatment In the treatment of bone cyst fracture healing may be anticipated following simple immobilization. However, in any but the very small lesion the cyst will in most cases remain unchanged leaving a *locum resistentiae minoris*. Hence, curettage of the cyst with insertion of bone chips and open reduction of the fracture is recommended as the procedure of choice in these cases. Immobilization will not need to be prolonged beyond 4 or 5 weeks in the upper extremity, but its duration in fractures of the lower extremity will have to be determined by x-ray study of the strength of local repair.

4 Giant cell tumor (5 cases) In 2 patients treated by curettage and the placing of bone chips within the cavity the fractures healed rapidly with bone replacement. In 1 patient treated by plaster immobilization and radiation callus was formed in 1 month but the bone became markedly atrophic. Three years later the cyst was still evident even though the fracture remained united. In another patient treated by curettage and radiation there was delayed union, another treated by immobilization and radiation showed union with bone regeneration visible in 3 months.

Treatment From these cases one concludes that curettage and filling the defect with bone chips followed by plaster immobilization is the

most certain and rapid treatment for pathological fracture through a giant cell tumor.

5 Rickets (5 fractures in 3 patients) In patients whose fractures were treated only with local measures healing time was prolonged, but union, when it occurred, was thorough. In 2 fractures which received intensive doses of vitamin D healing occurred in 4 to 5 weeks. One of these latter was a fracture of the femur. These results confirm the observations of Lereboullet and Chabrun who reported 3 cases of multiple pathological fractures in children with rickets. It has been repeatedly demonstrated that while the exhibition of vitamin D does not increase the healing rate in non-rachitic fractures, its effect is specific upon the acceleration of healing in the presence of rachitic fractures.

Treatment Immobilization and anti-rachitic therapy lead invariably to early and firm union. Without intensive anti-rachitic therapy healing may be retarded and the callus relatively soft.

6 Gaucher's disease There were 4 cases of pathological fracture due to Gaucher's disease. In 2 the tibia was involved, in 2 others the vertebrae, and in 1 of the latter the sternum was involved as well. In the fractures of the long bones it was found that with simple immobilization union was delayed 14 months for clinical union and thus invited intervention. In one instance open operation was complicated by postoperative osteomyelitis, but even here union occurred after subsidence of the infection. In the vertebral fractures with immobilizing procedures the progress of the lesion stopped and the fractures were considered "healed with deformity" when the patient



Fig. 3 Osteogenic sarcoma fracture healing.

was able to walk in comfort. References to pathological fractures in Gaucher's disease are rare. No case reports could be found which discussed the fracture in relation to treatment or reported the end result of a specific instance. Eliason stated that the prognosis of the disease is poor but the cases reported in the present group show that union of the fracture and rehabilitation of the patient should be expected.

Treatment. In lesions of the flat bones simple immobilization or rest in bed is sufficient; a spinal brace serves sufficiently as after treatment in vertebral cases. In the long bones the evidence from this group of cases indicates that union can be anticipated following a prolonged period of immobilization. In any event plaster immobilization must be maintained until there is clinical evidence of union over a period of several months. Otherwise with the lesion still present, refracture is apt to occur. In the one instance where open operation was performed infection supervened.

7. Osteitis deformans—Paget's disease (4 cases). All of these patients healed in normal time with simple immobilization. However the regenerated bone was no stronger than the thick but fibrous bone of the prefractured stage. Fracture did not stimulate the progress of the disease nor retard it. Eliason states that union in Paget's disease is slow. However Rogers and Ulin, reporting 8 complete cases, found callus to be normal or probably better than normal and the care of these fractures was not difficult. Woytek concurred in this opinion. Bloodgood states that non-union of a fracture in Paget's disease suggests the development of sarcoma.

Treatment. The 4 cases reported in this study confirm the general opinion that pathological fractures in Paget's disease heal well and in normal time following treatment by simple immobilization or traction. This need not be maintained longer than the time required for fractures through normal bone but some form of light protection should be used for a month or 6 weeks thereafter and the patient warned about the susceptibility of any of his affected bones to refracture.

8. Chondroma (4 cases). These cases all occurred in the phalanges and metacarpals. All healed rapidly with regeneration of the lesion following curettage and the insertion of small bone chips. There were no cases of simple chondroma without pathological fracture of the long bones. These observations are in keeping with the reports of others. Eliason stated that chondroma fractures do not heal until the tumor is excised. Weinberg, studying 160 pathological fractures in 1700 bone tumors, stated: "In cartilaginous tumors involving the long bones with medullary destruction a pathologic fracture is usually an indication of some variant of chondrosarcoma."

Treatment. Curettage, the insertion of bone chips and immobilization from 6 to 7 weeks is the indicated procedure for these patients.

9. Osteofibrous dysplasia including localized osteitis fibrosa cystica and osteofibrous dysplasia (3 cases). In these patients the fractures healed in normal time when treated by simple immobilization. Regeneration of bone through the underlying lesion followed treatment with or without surgical intervention. When curettage and the insertion of bone chips was performed, regeneration proceeded much more rapidly than when these measures were not employed.

Treatment. These cases were too few in number to warrant final judgment. Previous reviews of pathological fractures quoted above agree in the general statement that these fractures heal in normal time with some instances of coincident filling of the defect following simple immobilization. On the basis of the present cases and compared with other similar lesions one might state in the absence of further series of specific case reports on the subject that these fractures invariably heal under conservative treatment but that the lesion in most instances remains a locus resistens minoris unless curetted and unless osteogenesis is stimulated by the insertion of bone chips. The necessity for removal of the adventitious tissue in the treatment of these fractures should be judged by the location of the lesion at points of excessive strain in the extremities and by the relative volume of the bone segment affected.

10 *Osteogenic sarcoma* Two of the 3 patients showed evidence of healing before death. In 1 of these a fracture of the shaft of the femur was sufficiently well healed 6 weeks after it occurred to permit walking. Treatment in each patient consisted of (1) plaster and (2) plaster and radiation. In the third patient the sarcoma was progressively destructive until death. Radiation was used in 1 of the united cases and not in the other. It was also used in the progressively destructive case.

Treatment Plaster immobilization is indicated. Radiation may be used to palliate pain but will not contribute to healing. Duration of the period of immobilization can be determined only by x-ray observation, although after evidence of clinical union a splint for the upper extremity or brace for the lower may be suitable.

11 *Neuropathies, including paralysis agitans, poliomyelitis, tabes, general paresis, syringomyelia, spina bifida* In 2 out of 3 fractures in this series healing occurred in normal time following simple immobilization. There were 2 cases of paralysis agitans and 1 of poliomyelitis. The prognosis is said to be good in tabes (9) and syringomyelia (17). Bloodgood noted that fractures in tabes are most common in the lower extremities and in syringomyelia in the upper extremities. Achard, and Sicard and Roger, have reported cases of pathological fractures in tabetics with healing following immobilization, massage, supervised active motion, and anti luetic therapy. Alajouanine, Mauric and Camus reported a healed case in syringomyelia following conservative therapy. Camus found 18 cases of pathological fracture in syringomyelia in the literature up to 1927. Healing



Fig 5 a luetic osteoperiostitis fracture b luetic osteoperiostitis fracture healed

always takes place though retarded with conservative therapy. Trumpeier and McNealy reported 2 cases of fracture in poliomyelitis and noted that while healing takes place under conservative therapy the resultant callus is weak, because the functional stimulus is absent.

Treatment Immobilization procedures are sufficient in these cases and healing will take place in normal time, but the part must be protected against refracture for a prolonged period. Early functional stimulation with protection is the most effective treatment.

12 *Osteomyelitis (2 cases)* These fractures will unite with simple immobilization when the osteomyelitis is in the regressive or healing stage. When the infection is actively progressive, it will destroy the newly formed bone more rapidly than callus can be deposited. Capener and Pierce studied 18 cases of pathological fracture in osteomyelitis. In 9 patients firm union was eventually obtained though often considerably delayed.

Treatment Fracture is a complication of chronic osteomyelitis and is almost invariably preventable. It occurs most often in bone following extensive saucerization when the structure is weakened. This should be kept in mind and protection afforded to a saucerized bone even in the upper extremities until such time as sufficient repair is present to assure stability. When it occurs in an active or progressing infection, the area should be completely saucerized not only as treatment for the osteomyelitis but also to insure union. Following this the bone should be completely im-



Fig 4 a left Bone cyst fracture b Bone cyst fracture healing

mobilized until union takes place and until the osteomyelitis has either been removed or become quiescent

13 *Endothelial myeloma (Ewing) hypernephroma multiple myeloma* Since these 3 malignant neoplasms produce similar lesions structurally in bone though histologically different their treatment is the same. One such case that of a Ewing tumor involving a cervical vertebra was among the present series. No union could be discovered at the time of death 2 months later. However in Coley and Sharp's paper 5 cases of Ewing tumor are cited in which healing did occur. Rybins reported a case of hypernephroma with pathological fracture through metastases in the bones of the forearm which later united. Gottesman Perla and El on studied 44 cases of hypernephroma and found no evidence of healing in any of their series when pathological fracture occurred. Bloodgood found 1 example of ossification in a fracture through multiple myeloma and 1 through hypernephroma.

Treatment Radiation is exhibited as a palliative measure. Beyond this simple immobilization by traction or splint will help to relieve pain. Union is most exceptional and cannot be anticipated.

14 *Syphilis and syphilitic osteoperiostitis* In 1 case of fracture through a bone rarefied by luetic osteoperiostitis there was complete restitution to normal in 2 months following immobilization of the fracture and anti luetic treatment. In a second case a pathological fracture occurred in a luetic patient without evidence of local bone inflammation. This case healed well without any immobilization only the radius was fractured at its mid shaft without displacement and following anti luetic measures resumed a normal appearance. Sezary and Jonesco reported an instructive case of repeated pathological fractures in a non tabetic luetic patient in which final cessation of fracture followed intensive anti luetic therapy. Galliot also published an excellent review of pathological fractures in acquired syphilis, including an extensive bibliography. His experience as well as that of Grunert in 1905 confirms the 2 observations reported in the present series.

Treatment When pathological fracture occurs in a luetic patient immobilization or traction supplemented by active anti luetic measures is the treatment of choice. One may thus anticipate complete restitution of the bone structure to normal within the time ordinarily allowed the same fracture in a non pathological bone and avoid a repetition of pathological fracture elsewhere in the skeleton.

15 *Fibrosarcoma* The present case could not be duplicated in the literature available. A fibrosarcoma involving the upper end of the femur was excised and bone chips were inserted. The fracture was united 9 months later. However this procedure cannot be advocated as one of choice and the case must be considered an exceptional instance of low grade malignancy.

Treatment Such patients are to be treated as are those with pathological fractures through osteogenic sarcoma (vide supra). The above sections discuss pathological fractures represented in the present series or those whose lesions are closely allied to them in structure and effect on bone. Other susceptible lesions will be mentioned briefly only where published case reports include a description of the treatment and the end results. References to such lesions will be cited in the bibliography without further discussion.

ANALYSIS OF ADDITIONAL LESIONS

1 *Osteopetrosis marble bones Albers Schoenberg's disease* These unite promptly with conservative therapy but in spite of the hardness of the bone and its implied durability the bones are fragile and a tendency to fracture increases with the progress of the disease (19). Because of this Pirie preferred the term chalky bones. Merrill reports a case in which 4 fractures occurred 3 being local recurrences. In each patient union occurred following conservative care (22). Compere saw 12 cases of marble bones with 5 fractures. These united well but recurrences were frequent up to the age of 30.

Multiple spontaneous idiopathic symmetrical fractures osteoporosis melolytica In these patients no clinical union occurs and the slow dissolution of continuity of the bones proceeds (20, 23). Brailsford contrary to other authors classifies these cases among the osteomalacias.

3 *Osteomalacia including hunger osteopathy, status cachecticus steatorrhea* Kurtzahn reported a series of cases in 1929. Golsman and Compere studying 10 cases of fractures in atrophic bone gained the impression that 'union occurred as readily in fractures of atrophic bones as in fractures of bones of normal density' (See also 32, 35).

4 *Senile atrophy atrophy of disuse* Westphal found that atrophic bones associated with joint tuberculosis heal normally.

SUMMARY AND CONCLUSIONS

1. Fifty nine patients in whom 85 pathological fractures occurred were studied in reference to the effect of treatment on union. In each patient the pathological lesion or skeletal abnormality was

known, and sufficient clinical and roentgenological data were available to warrant conclusions. These were compared to case reports available in the literature. From this material it is possible to evolve certain rules or principles which, it is hoped, will assist in formulating treatment applicable to pathological fractures in general, whether the underlying pathology be unique, rare, or relatively common.

2 Trauma is in itself always a stimulus to reparative osteogenesis in pathological fractures.

3 The extent of repair in pathological fractures is a function chiefly of the density of pathological tissue displacing bone and/or the volume of displaced bone requiring replacement.

4 The strength of reparative tissues when fully formed depends upon several factors: (1) the inherent soundness of the prefRACTURED bone, as in fragilitas ossium, osteopetrosis, or certain of the atrophies; (2) the available mineral content, as in rickets; (3) the progress, stasis or regression of the pathological lesion, as in osteomyelitis or certain neoplasms; and (4) the amount of viable bone which can be formed in the space permitting its deposition, as in the osteofibrodystrophies.

5 Reparative osteogenesis can be stimulated greatly in selected cases by curettage of the pathological tissue and deposition of bone chips. In certain lesions such as giant cell tumor or bone cyst in which union may occur under conservative care, this procedure will hasten and strengthen repair. Operation is especially indicated in cystic lesions or in those in which solid areas of bone are displaced, as distinct from those in which the pathological lesion merely permeates existing trabeculae.

6 Union between the residual normal bone adjacent to a persisting lesion is an invitation to refracture. Whenever feasible, that is when not specifically contra indicated by the pathology of the lesion, its removal and replacement by bone chips is advisable.

BIBLIOGRAPHY

- 1 ACHARD C Fractures du Tabes Bull méd 1937 45 775
- 2 ALAJOUANINE T MAURIC G and CAMUS L Fractures spontanées dans la syringomyelia Bull méd 1927 41 1317
- 3 BLOODGOOD J C In Scudder's Treatment of Fractures Philadelphia W B Saunders Co 1926
- 4 BRATSFORD J F Radiology of Bones and Joints 2d ed Baltimore William Wood & Co 1935
- 5 CAMUS L Les Fractures spontanées dans la syringomyelia These de Paris 1927
- 6 CAPPER N and PIERCE K C Pathologic fractures in osteomyelitis J Bone & Joint Surg 1932 14 501
- 7 COLEY B L and SHARP G S Pathological fractures in primary bone tumors of the extremities Am J Surg 1930 9 251
- 8 EISENDRATH D N and STRAUS D C Pathologic Fractures In Keen's Surgery Vol 7 Philadelphia W B Saunders Co 1921
- 9 ELIASON E L Pathological fractures Surg Gynec & Obst 1933 56 504
- 10 GALLIOT A Les fractures spontanées dans la syphilis acquise Ann d mal vén 1935 30 903
- 11 GORMAN J and COMPER E L Healing of fractures of atrophic bone J Bone & Joint Surg 1938 20 587
- 12 GOTTESMAN J PERLA D and ELSON J Pathogenesis of hypernephroma Arch Surg 1932 24 722
- 13 GRUNERT In Paul Brun's Lehre von den Knochenbrüchen Stuttgart Enke 1886
- 14 HANDLEY W S Cancer of the breast Surg, Gynec & Obst 1915 20 72
- 15 HUMMEL R Zur Frage der Festigung von Spontanfracturen bei Karzinometastasen im Knochen Fortschr a d Geb d Roentgenstrahlen 1934 50 529
- 16 KAPLAN, E B Multiple fractures associated with blue sclera J Bone & Joint Surg 1934 16 625
- 17 KOCH Syringomyelia and Unfall Klin Wchnschr 1927 6 41
- 18 KURTZAHN Spontanfracturen bei seniler Osteomalacie Deutsche Ztschr f Chir, 1929 278 407
- 19 LAMB F H and JACKSON, R L Osteopetrosis (marble bone disease) Am J Clin Path, 1938 8 255
- 20 LEEDHAM GREEN J C and GOLDING F C Osteopetrosis melolytica Brit J Surg 1937 26 77
- 21 LEREBoullet and CHABRUN J Fractures multiples chez la nourissons rachitiques Bull Soc de pediatrie de Par 1931 29 151
- 22 MERRILL A S Case of marble bones with pathological fractures Am J Roentgenol, 1929 21 367
- 23 MILKMAN, L A Multiple spontaneous idiopathic symmetrical fractures Am J Roentgenol 1934 32 622
- 24 MURRAY C R Healing of fractures Its influence on the choice of methods of treatment Arch Surg 1934 29 446
- 25 PRIE, A H Development of marble bones Am J Roentgenol, 1930 24 147
- 26 RASSIEUR L Pathological fractures Missouri M J, 1927 18 400
- 27 ROGERS M H and ULIX, R Fractures in Paget's disease J Bone & Joint Surg 1936 18 974
- 28 RYBINS E L Union of pathological fractures following metastatic hypernephroma Am J Cancer, 1934 20 607
- 29 SÉZARY A and JONESCO N Fractures spontanées chez un syphilitique nontabétique Bull et mém Soc méd de hóp de Par 19 9 53 585
- 30 SICARD J and ROGER H Fractures spontanées du tabes et de la paralysie sciatique par section du nerf Marseille méd 1918 55 677
- 31 TRUMPER I H and MCNEALY, R W Fragility and deficient healing of bone in polyomyelitis J Am M Ass 1930 95 19
- 32 WEINBERG D Pathologic fracture Radiology 1931 16 282
- 33 WELCH C E Pathologic fractures due to malignant disease Surg Gynec, & Obst 1934 62 735
- 34 WESTPHAL G Spontanfracturen bei atrophischen Knochen infolge endzündlichen Gelenkerkrankungen Deutsche Ztschr f Chir 19 9 276 342
- 35 WOYTEK G Ostitis deformans Paget und Frakturdisposition Monatschr f Unfallheil, 1937 39 560

EDITORIALS

SURGERY Gynecology and Obstetrics

FRANKLIN H. MARTIN
Founder and Managing Editor
1905-1935

LOYAL DAVIS EDITOR

Associates

SUMNER L. KOCH MICHAEL L. MASON

DONALD C. BALFOUR Associate Editorial Staff

OCTOBER 1939

THE DIAGNOSIS OF PANCREATIC DISEASE

SINCE the year 1927 which was also the date of the publication of Robert Coopers monograph *The Diagnosis of Pancreatic Disease*, there has been a rapidly growing interest in surgical diseases of the pancreas despite the low morbidity index for this organ. That this is true is evidenced by the considerable number of papers on clinical and experimental aspects of pancreatic disease appearing in the literature. The problems concerned with diagnosis and differential diagnosis are of the greatest importance and have received much attention. The history, physical findings, routine laboratory studies and roentgen examination have all too frequently yielded inconclusive diagnostic data. This fact led to the development of special diagnostic procedures which attempted to detect the failure of the discharge of pancreatic juice into the duodenum such as for example, the appearance of bulky stools, indoxyluria, the absence of pancreatic

ferments from the stomach, duodenum and feces and the excess of nitrogen and undigested muscle fibers and fat in the feces.

In addition to these more direct measures others less direct were advocated and efforts were made to obtain diagnostic information by introducing substances into the gastrointestinal tract, normally digested by pancreatic juice. The glutoid capsule test of Sahli and Schmidt's beef cube test were notable examples of this type of study. The carbohydrate metabolism was also investigated by means of quantitative blood sugar estimations and sugar tolerance tests and inferences as to the functional state of the pancreas were made on the basis of these determinations. Some of the tests proposed now seem almost fantastic and Cooper refers to such procedures as Loewi's adrenalin mydriasis test and particularly Cambridge's urine test as 'esoteric'. Most of these methods are now obsolete and rarely used.

When Wohlgemuth in 1908 made observations on the diastase of the blood and urine in health and disease a new and more rational avenue of approach to the problems of diagnosis in diseases of the pancreas was opened. In clinical practice it was early recognized that in a number of diseases of the pancreas the concentration of diastase in the blood and in the urine was elevated above the normal level. Observations of experimental physiologists had shown that when the pancreatic ducts in animals were ligated the diastase of the blood became enormously increased. A number of ingenious methods have been proposed for the quantitative determination of the diastase concentration in the blood and urine. The four principal methods described

in the literature are (1) the iodometric, (2) the copper reduction, (3) the viscosimetric, and (4) the polariscopic. In 1938, Somogyi declared that all existing micro methods were inadequate for the quantitative measurement of diastase and proposed a modification of the Wohlgemuth test which in our opinion is simple, rapid, and accurate.

Unfortunately the rise in the diastase of the blood, due to stasis of the pancreatic juice, localized either to a portion of the gland or generalized throughout, is transient and rarely lasts for more than a few days. Many surgeons and clinicians now recognize this limitation of the test but as yet it is not generally appreciated. The following explanation for the behavior of the diastase curve seems logical. Any pathological process causing mechanical obstruction such as calculous inflammation, cyst, or neoplasm interferes with the free discharge of pancreatic juice and results in a damming back of the external secretion. The ferments then become concentrated in the blood stream and are gradually eliminated in the urine. If the obstruction continues, pressure atrophy of the acinar cells develops and the elaboration of the ferments ceases, the diastase in the blood soon returns to normal or nearly normal levels where it is probably maintained by the liver. Obviously the interpretation of the diastase values at this time may be very misleading. The test has been of greatest value in the acute forms of pancreatitis. In cyst of the pancreas it is said to be positive in about 50 per cent of the cases, while in chronic pancreatitis and in neoplastic disease the determinations are often of little or no value.

Other methods for dealing with this problem have been studied experimentally. The excretion of various dyes by the pancreas has been investigated by a number of experimentors but the results have been discouraging. The

fact that the diastase in the blood of dogs begins to rise within an hour after ligation of the ducts suggests a possible line of investigation, for if the orifices of the pancreatic ducts could be temporarily occluded in some manner, this rise might be taken as an index to the functional integrity of the gland. Further research is needed.

In our opinion the estimation of blood diastase is the most valuable single diagnostic test for acute pancreatic disease known at present, but the results must be properly interpreted and correlated with other laboratory and clinical data.

JOHN M. McCaUGHAN

SERUM AMYLASE IN THE DIAGNOSIS OF PANCREATIC DISEASE

AMONG the more promising methods for the detection of pancreatic disease is that of determining the activity of amylase in the serum. Its beginning may be traced to Wohlgemuth, who, in 1908, described a quantitative method for measuring amylase, based on the hydrolysis of starch into erythrodestrins and maltose, using iodine as a test substance. The determination of the amylolytic activity of the serum as a method of diagnosis of pancreatic disease has been increasingly well defined during the past 30 years by accumulating experimental and clinical data, and now the method seems to be approaching maturity after many years of alternating enthusiasm and neglect at the hands of the internist.

The measurement of amylolytic activity can be accomplished either by physical or chemical methods. An illustration of physical methods is the viscosimetric method, in which the change in viscosity due to hydrolysis of starch by the enzyme amylase is measured

Chemical methods usually depend either on measurement of the rate of disappearance of starch as determined by the color produced by iodine or by the measurement of the quantity of maltose or glucose liberated by the enzyme. The values for amylase in the serum are expressed in various terms depending on the method used. Data collected by use of these methods have shown that amylase is constantly present in the blood stream that in healthy individuals amylolytic activity is relatively constant but that this activity may vary considerably in different persons. Amylolytic activity is said to be unaffected by starvation or by foods of various types.

Considerable information about the origin and fate of amylase has been accumulated and it is now believed that amylase arises partly at least in the pancreas. Several reasons for this belief can be advanced. First experimental pancreatectomy performed on animals has been followed with few exceptions by decreased levels of amylase in the serum. Second, ligation of the pancreatic ducts of animals always has been followed within a few hours by a rapid rise in values for serum amylase these values gradually returning to normal in 8 to 15 days. Third pancreatitis induced experimentally by injection of bile into the pancreatic duct has been followed routinely by marked increase in concentration of amylase in the serum maximal values being reached within 72 hours and the return to normal usually occurring within the first week, even though pathological changes persist in the pancreas. Fourth a subcutaneous injection of acetylcholine is followed by an increase in values for amylase in the serum of the intact animal while such an increase fails to take place if pancreatectomy has been performed previously. Amylase in the serum may however, have an extrapancreatic origin for as McCaughan recalled, Wohlgemuth Polacco,

and Medina showed that obstruction of Stenson's duct also resulted in increased amylolytic activity of the blood and urine. Amylase in the pancreatic juice, after its entrance into the duodenum, probably is not a source for amylase in the serum since it has been shown that the concentration of amylase is not affected by drainage of the pancreatic juice to the exterior.

Amylase probably is absorbed directly into the blood stream from the pancreas in health while in the presence of experimental or clinical obstruction of pancreatic ducts, and in the presence of pancreatitis, it is presumed that rupture of small pancreatic canaliculi occurs permitting entrance of pancreatic juice into the blood stream through the lymphatic vessels. The factors which maintain the normal concentration of amylase in the serum are not well understood. It may be assumed that the pituitary gland exerts some influence inasmuch as removal of the pituitary glands of dogs is followed by a twofold increase in the concentration of amylase in the serum. Amylase is excreted through the kidneys and through the liver and both urine and bile probably serve as vehicles for elimination of excess amounts of amylase.

Theoretically, destruction of the acinar tissues of the pancreas should be followed by lowered values for amylase and low values have been reported in the presence of chronic pancreatitis. Low values also have been reported to have been found in the presence of cholecystitis, of various conditions of the liver such as hepatitis, cirrhosis, abscess, and carcinoma as well as in the presence of diabetes, severe toxemia of pregnancy, and pneumonia. The finding of low values in the presence of some of these conditions is difficult to explain and suggests that the role of the liver in the maintenance of normal values should be investigated further. The multiplicity of conditions in which low values have been reported

renders such values of questionable significance in the diagnosis of diseases of the pancreas

Elevated values for amylase in the serum have been recorded both in cases of inflammatory disease of the pancreas and in cases of obstruction of the pancreatic ducts by carcinoma or by cyst of the pancreas. Since elevated values persist only for a few days after the onset of inflammation of the pancreas, the determination must be carried out within this period if the result is to be positive for inflammatory disease of the pancreas. Elevated values may persist for a longer period when the duct is obstructed by neoplasm. The determination is positive for pancreatic disease with great frequency, provided the determinations are carried out within the first few days after the attack of upper abdominal pain or during the acute phase of obstruction of the pancreatic duct.

Although elevated values for amylase in the serum have been reported in the presence of nephritis, this fact should not be considered to detract from the usefulness of the determination in the diagnosis of pancreatic disease. A greater source of error in clinical application of the test possibly may arise from obstruction of the common bile duct, for it has been shown that experimental ligation of the common duct

leads to increased values. Until now, elevated values have not been, and it seems unlikely that they will be, identified as being due to obstruction of the common bile duct, inasmuch as Wakefield, McCaughan, and McVicar found elevated values in only 4 of 18 cases in which the common bile duct was obstructed by carcinoma of the head of the pancreas. Even in such cases considerable doubt exists that obstruction of the common bile duct was responsible for the high values and it seems unlikely that the more incomplete and more transient obstruction caused by stone in the common duct will cause elevation of values for amylase in the serum and thus prove a significant source of error in the clinical application of the test.

Although it is true that elevated values do not necessarily mean pancreatic disease, elevations due to other causes should not often confuse the diagnosis, and it seems safe to conclude that elevated values will point to inflammation of the pancreas or to obstruction of the pancreatic duct with a high degree of certainty. The determination of the concentration of amylase in the serum seems to be well established as a test of pancreatic disease and should be more extensively used in the diagnosis of disease of this organ.

M. W. COMFORT

MEMOIRS

DR WILLIAM J MAYO AS I KNEW HIM

OWEN H WANGENSTEEN, MD, FACS Minneapolis Minnesota

DR WILLIAM J MAYO is dead

Born into a country physician's family in Le Sueur, a small frontier village in Minnesota, in the early days of the American Civil War, he was destined to become the first citizen of the commonwealth of Minnesota and a figure of the first rank in the world of medicine, bringing undying luster to the name of Mayo and enduring fame to Rochester Minnesota where he lived and worked

Dr Mayo was a man who would stand out in any group of men. He was of medium height, his bearing was erect, his step quick and firm, even in his later years and his alert eyes were steady and intent. In manner he was unpretentious and a quiet dignity characterized his every action. His conversation was lively and cheerful and gave evidence of a broad general interest. His capacity for reducing important principles whether in discourse or writing to an apologue or illustrative anecdote was proverbial and all his expressions were uniformly moderate in statement. Dr Mayo was a good listener and lent an attentive ear to any conversation to which he was a part. His extraordinary memory for fact and fact was in part owing no doubt to the earnest and concentrated interest which he lent even casual meetings.

What was the philosophy of life of this remarkable man who in a small mid western town with the aid of his brother Dr Charles H Mayo, built a medical clinic that has been long the wonder and marvel of the entire world? Frugal and abstemious in habit, simple in tastes and temperate in all things but work, his daily example illustrated the great principle which regulated his life and which he himself expressed so well: "Contented industry is the mainspring of human happiness." From earliest years to his last he loved his work. There were no spasms or episodes of labor. His life was a long, patient, and continued effort. What is labor when the sun of success shines upon a man's exertions? When Dr Mayo gave up his work in the operating theater, which he loved so much at the age of 68, his other clinical activities absorbed his entire time and interest. He remained always a perpetual wonder to his associates who could not understand how he could find complete satisfaction and enjoyment in constant hard work. When he needed relaxation he found it in some other activity. Diversion of the vacant hour were the companionship of his family, thoughtful reflection upon

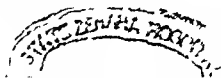
the verities of life, reading, travel, and his river boat In his active years he seemed indefatigable and under whatever stress he found himself, he exacted always a higher standard of work from himself than from his associates A noble maxim, dear to his heart, which adorned his desk, animated his work and gave it direction It read "He loved the truth and sought to know it"

What were the qualities of this man that made it possible to accomplish in a single life span the Herculean tasks which he carried through? A lofty objective with earnestness and singleness of purpose, unrivaled capacity for leadership, unsurpassed vision, a well balanced critical but tempered judgment, an ability to make time go a long way, indomitable determination, flexible adaptability and a genuine tolerant sympathetic patient understanding, accompanied by a calm serenity, were some of the characters that set Dr Mayo aside from other men

How Dr Mayo succeeded uniformly in getting everyone about him to do his bidding willingly is a source of never ceasing wonder Since the beginning of time, the distinguishing mark of eminently successful leaders has been the dual capacity to envisage a far reaching intelligent program and the ability to carry it through with the complete and voluntary consent of the governed Dr Mayo possessed both these talents in liberal measure To command the complete confidence and loyalty of associates in undertakings which at the time had the suggestion of being somewhat visionary is in itself a real triumph The success motif runs conspicuously through all activities to which Dr Mayo put his hand Capable generals who lose battles discover usually that their popularity was lost with the conflict Certainly nothing succeeds so well as success The astonishing success of his enterprise attests not alone the acuity of Dr Mayo's unusual mental perception but as well his skill in the choice and the management of associates

Dr Mayo recognized true merit and rewarded it liberally There was no envy in his make up—no ambition to hold the stage alone Associates were given free rein and excellent opportunities to develop their individual capacities Dr Mayo lent encouragement often by an unexpected kindly act or a word of praise His criticisms were few and friendly

Let us look at this man at work in his surgical clinic Here it was he first established himself as a surgeon of distinction Here again, natural endowment with rare combinations of talents permitted him to make an enduring contribution to surgery Early world wide recognition as surgeons came to the brothers Mayo for their ability to carry out operations upon the gall bladder, bile ducts, and stomach, with exceptionally low mortality rates Medical men came to see, doubtful of the incredible reports they had heard and read emanating from Rochester They came away bewildered by what they saw and, if they went to Europe, they encountered great enthusiasm for the surgery done at Rochester Those who live within the pale of a great man's shadow are often slow to admit or



appreciate fully the things which the rest of the world acknowledged long since until the echo of his fame returns to their very doors. The world gives its admiration not to the man who does what nobody attempts to do, but to the man who does best what many do well. The masterly adroitness of Dr. Mayo in operations upon the stomach, colon and rectum, hernia, the biliary passages, spleen, and kidney are well known to all who were privileged to observe him at work. His manipulations were delicate and precise. A fine tremor did not impair the accuracy of his handiwork. His mental calm in trying situations was admirable. He was a surgeon's surgeon, an affirmation of his superior judgment in making and executing difficult decisions. On completion of an operation, he would review in a modest chatty manner the nature of the problem as it presented itself, discussing the alternative manners in which the problem may have been solved, giving the reasons for his choice of procedure. These remarks gave evidence always of profound knowledge of the recorded experience of others, tinged by the wisdom which comes from a critical analysis of a broad personal experience. Dr. Mayo was in no sense a slave of authority; on the contrary, he was always in the lookout of the watch tower searching the horizon for new ideas. Yet his every act indicated that he valued the knowledge of the past as a priceless possession, evincing however the capacity to sympathize understandingly with other times.

Dr. Mayo found the surgeon working alone with assistants of a kindred spirit in his workshop. He succeeded in exciting the curiosity successively of pathologist, roentgenologist, and internist in surgical problems and brought into the surgical clinic the experience of a group of men whose special knowledge pyramided the usefulness of the surgeon. This contribution of Dr. Mayo has left an indelible impress for the better on the practice of medicine that has been felt around the world. Wherever this principle of surgical practice is in force one can be certain that the surgery is of a high order. Dr. Mayo's recognition of the importance for the surgeon to limit his activity to a somewhat circumscribed field has done much to advance surgical specialism in this country. One who essays to encompass the entire field of surgery remains all his life a learner and can make no significant contribution to the patrimony of surgical knowledge. Dr. Mayo did insist however that every surgical specialist must be grounded broadly in the province of general surgery.

Having co-ordinated intimately the activities of his clinic, this man who saw with extraordinary perspicacity placed his institution in part under the observant discipline of a graduate school of medicine with university supervision. Obstacles did not deter him. He established an experimental laboratory of surgery, brought bacteriologist, chemist, biochemist, physicist, and biophysicist into intimate contact with many phases of the practical work of the clinic long before this practice was the fashion or its great value to a clinic appreciated. Little wonder that this practical dreamer's vision has made of his effort a monument that attracts

medical men and patients from everywhere. The innovations which Dr Mayo made in clinical and hospital procedure indicate that he meditated and reflected continuously upon new schemes and disciplines which could be introduced for the betterment of medical practice. He was always in the vanguard of progress.

Dr Mayo's interest in the young man was unceasing. He urged the young aspirant, ambitious for a career in medicine, to give intelligent thought to the general problem of social conduct and relations to his fellow man. Many a man who professes the moral code employs it as a lightning conductor. For Dr Mayo it was the guiding light of his daily life—an obligation indispensable to happiness. Another precept to which Dr Mayo lent directional momentum, not alone by repeated exhortations but by the more cogent impetus of example, was the necessity for systematic and continued study. A man of improved faculties, Dr Mayo counselled, has command of another's knowledge. He felt keenly that the wisdom of age and experience should be exchanged freely with the enthusiasm of youth and that both old and young would benefit greatly by the barter. Said Dr Mayo: "As I have watched older men as they have come down the ladder, as down they must come, with younger men passing them, as they must pass to go up, it so often has been an unhappy time for both. The older man is not always able to see the necessity or perhaps the justice of his descent and resents his slipping from the position that he has held, instead of gently and peacefully helping this passing by assisting the younger man."

Despite the absorbing nature of his work, Dr Mayo found time for many other activities. For a period of thirty two years he was a Regent of the University of Minnesota and took a very active part in the deliberations of that body. During this long period of service he cultivated constantly an intense interest in the broad outlines of general education and gave special attention to the history of education. His opinions upon educational matters were respected and he was much sought after as a speaker at university exercises. He gave much thought to medical education, both undergraduate and graduate, and took an active interest in the efforts of established medical organizations to improve and elevate the general plane of practice. Since its beginning, he was identified intimately with SURGERY, GYNECOLOGY AND OBSTETRICS and participated actively in the functions of the American College of Surgeons.

One of the very beautiful and exemplary things relating to the brothers Mayo was the devotion and attachment of one to the other. It was more than a fraternal interest, yes, something akin, in each instance, to that of a father's solicitude for his son, a spirit which we would all do well to emulate. Doctors Will and Charlie, as they were affectionately known to their intimates, spoke often with a tender fondness of the lessons they had learned from their parents. Dr Will credited his father with many an important precept that stood him in good stead throughout his professional life. To both his mother and his father

he attributed prudent instructions in social obligations—of which his entire life reflected an unusually fine appreciation. Together the brothers Mayo gave liberally of their earnings to the Mayo Foundation for Graduate Medical Study and Research. In all, two and a half million dollars was donated by the brothers Mayo for this purpose. In a letter addressed to the University of Minnesota accompanying the last gift, Dr Mayo expressed in beautiful and simple language the philosophy that had prompted their philanthropy. He said in part: 'Our father recognized certain definite social obligations. He believed that any man who had better opportunity than others, greater strength of mind, body, or character, owed something to those who had not been so provided, that is, that the important thing in life is not to accomplish for one's self alone, but for each to carry his share of collective responsibility. The fund which we had built up and which had grown far beyond our expectations had come from the sick, and we believed that it ought to return to the sick in the form of advanced medical education which would develop better trained physicians, and to research to reduce the amount of sickness. The people's money of which we have been the moral custodians is being irrevocably returned to the people from whom it came.'

Many honors from all parts of the world came to the brothers Mayo, and their list of citations, decorations, and honorary degrees is most impressive. Both brothers valued these manifestations of esteem of their fellow men, but honors were held lightly by these modest and good men who retained their simplicity while occupying high positions in the world. Both the Doctors Mayo were loyal law-abiding peace-loving patriots, ardent in undivided devotion to their country, which had rewarded their dreams and ambitions far beyond their most sanguine expectations.

Men like Dr William J. Mayo, who are destined to guide the fate of empires or great enterprises, can not enjoy or gratify their capacities for friendship to the fullest. It is inevitable that they must often walk alone and keep their own counsel, however much they would share their hopes and regrets with their intimates. It is to the glory of Dr Will, however, that in the circle of his friends and associates he was loved even more than he was honored. Dr Mayo was a very domestic and home-loving man. The deep ties of affection to his family and kin were beautiful to behold. The door of the Mayo household was open always to friend and stranger who shared his interests, and the generous cordial hospitality of Dr and Mrs Mayo excited the warm admiration of all who were fortunate to know it.

Sweet is the recollection of this kindly man of rare gifts. His memory falls tenderly yet sadly on the spirit. His remembrance will be cherished with pride and affection by those who were privileged to know him. He belongs now to the infinite. His name will not perish in the dust.

THE SURGEON'S LIBRARY

REVIEWS OF NEW BOOKS

THERE has been a definite need for a book in the English language on the subject of *Orthopedic Appliances*. The book by Dr Jordan meets this need. The advantages and disadvantages of orthopedic appliances are noted, and the principles of application, technique of construction, and method of fitting mechanical supports are described. The author stresses the need for co operation between the surgeon and the brace maker and points out the responsibilities of each.

The book is useful to all who prescribe orthopedic appliances. The responsibility of choice of brace and supervision for proper fitting falls upon the surgeon who prescribes the appliance. It is also useful to the brace maker. Technical details are clearly stated for the brace maker to follow as to choice of material and methods of construction. The book is arranged so that it can be used as a reference to find a desired type of appliance. The appliances are grouped according to the anatomical parts to be supported and protected. It contains a chapter on the construction of several types of arch supports.

Dr Jordan reveals his continental training. He emphasizes the value of thorough, exact workmanship and shows a preference for form fitting braces. He also considers conditions in this country and takes into consideration the increased expense as well as the need of expert brace makers in the construction of form fitting braces. His use of a brace as a corrective mechanism is ill advised. The deformity should be corrected first, and the brace constructed to retain the correct position.

The author describes methods of constructing models and of taking measurements from which braces can be made. He describes and illustrates braces which have been proved by clinical use, including some which are outmoded and others which have not been described previously in the English or American literature. EMIL HAUSER

THE new edition of Means' and Richardson's work, *The Diagnosis and Treatment of Diseases of the Thyroid* covers the field simply but thoroughly, and is based on the extensive experience of the thyroid clinic of the Massachusetts General Hospital. Each chapter is followed by a bibliography of the important literature so that this volume becomes a valuable reference work. Approximately 50 selected

ORTHOPEDIC APPLIANCES. THE PRINCIPLES AND PRACTICE OF BRACE CONSTRUCTION FOR THE USE OF ORTHOPEDIC SURGEONS AND BRACE MAKERS. By Henry H. Jordan M.D. Foreword by E. G. Brackett M.D. New York London Toronto Oxford University Press 1939

THE DIAGNOSIS AND TREATMENT OF DISEASES OF THE THYROID. By James H. Means M.D. and Edward P. Richardson M.D. London New York Toronto Oxford University Press 1938

case histories, illustrating problems of diagnosis and methods of management, are used throughout the discussion. The gradual swing away from x ray to one stage surgical treatment of exophthalmic goiter is tabulated by 4 year periods in the material extending from 1915 to 1935. The treatment of hypothyroidism is given in detail. The work is representative of the common sense, accurate, and complete medical practice of this group. PAUL STARR

ONE may almost unconsciously accept the author's "semi humorous" style in reading one of his books. He has left this mouth and jaw subject until the last, and in his book, *Surgical Pathology of the Diseases of the Mouth and Jaws* states "so after thirty five years of writing, I shall trade my pen for a lollipop," but he does not promise to do so.

Whatever feelings a reader may have toward the author's homely style, fairness will show that an established principle for the good of the individual patient has been faithfully and admirably followed out, and a reader will only fool himself if he assumes that all the necessary "science" is not also included in the pages. The reader may be amused by such passages as the following "It is a question whether the lips should be considered a part of the face or as belonging to the oral cavity. The young swain, no doubt regards them as part of the face. Generally speaking however their most salutary function is to act as a portcullis for the oral cavity and to prevent the emission of sounds the unguarded vocal cords may feel impelled to emit." But there can be little doubt that the author has an unusual ability to reduce to words the processes one automatically goes through in arriving at a diagnosis.

The book is said to be intended for general surgeons but there are so many statements regarding the importance of diagnosis for correct treatment, and so many sallies into the field of treatment that one may wish the author would break down and go ahead with a full discourse on treatment of all the lesions included.

One finds good definite statements on microscopic confirmation of diagnosis before reporting cures of carcinomas, on the seriousness of lip carcinoma, on the unimportance of 'too much education' in the pathology of jaw tumors, on the unimportance to the patient of theoretical discourses on mixed tumors and regarding many other subjects that usually are discussed at great length.

SURGICAL PATHOLOGY OF THE DISEASES OF THE MOUTH AND JAWS. By Arthur E. Heller M.D. Philadelphia Montreal and London J. B. Lippincott Co. 1935

The photomicrographs are so clear that many of them look like drawings the photographs are also good and although one wonders why the entire face is included for small lip lesions by the time the middle of the book has been reached it just seems a nice personal introduction to see a tumor of the tongue shown in a patient with nose glasses. On page 189 however toward the end of the book the full face cadaver with the blotch on the palate described as a fibroma may leave one in deathly fear of such a process.

The author has experienced control of bleeding in malignant jaw tumors by external carotid ligation but perhaps by some surgeons who have not had such good success with this procedure one small mark may be made against the author's recommendations.

One who does this type of work will be glad to welcome the present text as a standard reference and will be delighted that the author found time to include this work in his series of 10 monographs on surgical pathology.

JAMES B. BROWN

IN this compact little book *Le traitement non sanglant des fractures du rachis*¹ Mallet Guy appraises the technique of Davis, Watson Jones and Boehler in their orthopedic non-operative treatment of fractures of the spinal column with emphasis on his own refinements and modifications of that form of treatment in the light of his own experience. He has personally treated by this method a series of 34 cases of fracture of the spine and in collaboration with René Leriche he has had the opportunity to extend his observations. Briefly the author's procedure is as follows: With the patient in the ventral position on a table and with the head and neck supported in a specially made ingenious contrivance (to extend the spine by forcing the head back with out undue strain on the atlanto occipital articulations) the muscles in and about the site of the fracture are thoroughly infiltrated with 1 per cent novocain solution and the spine is hyperextended as far as possible. A posterior molded body cast is fitted dried and completed the next day by an anterior molded half and the patient is then allowed to be up and about in order to perform specially designed exercises.

The author recognizes the fact that basically the idea of such treatment is not his but it is his purpose to stress its value in the treatment of old or recent spinal fractures (without attendant neurological lesions) and to point out the special advantage of the use of novocain rather than a general anesthetic to relax the muscles around the fracture and to simplify the application of the cast. His type of cast its method of application the special head rest and the exercises during the time of wearing the cast are all held by him to be important modifications of the original Watson Jones method.

Mallet Guy is particularly concerned with 3 anatomical types of fractures (1) the severely comminuted fragmented dislocated vertebral body (2) the opposite extreme the vertebra with a minimal transverse fracture in its interior without dislocation and without any involvement of the upper or lower meniscal surfaces and (3) an intermediate type the most frequent where the vertebra suffers a fracture with 1 or 2 fragments and the upper or lower surface of the body is fractured through with partial or complete destruction of the intervertebral disc. The sequelae of such fractures are pain deformity through both muscle imbalance and settling of the vertebra because of absorption and osteoporosis in the fractured body possible secondary neurological lesions and eventual loss of economic independence of the patient. He believes that the non-operative treatment requiring the use of a cast no more than 3 or 4 months usually should be tried before the open operation with laminectomy grafts and other radical often disappointing methods are used.

It is hardly to be expected that this monograph will be accepted in its entirety by every surgeon whose lot it is to treat spinal fractures. But no one can deny that it is a sincere exposition of the beliefs and experience of a surgeon of repute that it is written with assuring confidence and a clear understanding of this problem and that it is free of any extravagant optimism.

JOHN MAXIM

THE new 200 page book *A Manual of Fractures and Dislocations*² is divided into 4 parts the first part dealing with definition classification and diagnosis of fractures the second with fractures of the upper extremity the third with fractures of the trunk and the fourth part with fractures of the lower extremity. The methods and procedures are fundamentally sound and practical because they are based on the excellent results of fractures treated on a highly specialized fracture service.

In the first part the author advises careful history taking and thorough physical examinations. Specific clinical cases are used to emphasize and illustrate important points which are helpful to the reader. The author feels that the choice of the permanent treatment of a fracture should be made when the patient is first seen and the reduction performed as soon as possible. If operative interference is deemed advisable it should be performed within the first 10 days. The summary of technique in applying plaster strapping and aspirating of joints is well written and illustrated. Throughout the manual there are sketches and diagrams which are clear exact and self explanatory. At the conclusion of each discussion is a summary which includes very briefly the treatment time of immobilization prognosis and the salient points presented.

In fractures of the humeral surgical neck a word of warning is given as to the usual abduction plaster spica which is used. In fracture dislocation of the anatomical neck of the humerus Dr Stimson recommends removal of the head. Immediate internal fixation is advised in fractures of the shaft of the humerus. In fractures above the elbow the important landmarks are well illustrated and the possibility of growth disturbance is cited in slipped epiphysis in children suffering from injuries of the elbow. In gross displacement of the radial head, immediate removal is indicated and advised. Kirschner wires are recommended for comminuted fractures of the distal end of the radius. These wires are used for traction above and below the fracture and then incorporated in a circular plaster. In the discussion on hip fractures, the author lists 2 standard methods of treatment advocating both the Whitman spica and internal fixation, preferably by the use of a Smith Petersen nail. In most of the fractures of the shaft of the femur in adults, it is felt that some form of skeletal fixation is necessary. In fractures of the tibia and fibula the use of Kirschner wires is again recommended. Open operation for fractured patella is advised where there exists any separation of the fragments. In this chapter, an excellent and accurate definition and description of a Pott's fracture is given.

The manual is comprehensive, brief, and to the point. No attempt is made to describe surgical technique. The modern methods of treatment of fractures are presented very clearly and definitely. At the beginning of each part of the manual the incidence of fractures of each bone is carefully tabulated. These statistics are based on 11,000 cases treated at Presbyterian Hospital in New York City between the years 1929 and 1937. This manual is highly recommended for use by the medical student and the general practitioner.

FRANK E. STENICFIELD

THE title, *Everyday Surgery*¹ appears to defy the smallness of this book. Turning through its 266 pages one is astonished to find its scope almost comparable to that of the ordinary 1,000 page textbook of surgery. The authors suggest that students, post graduates, and the isolated practitioner may find practical aid in such a book. No doubt the under graduate student will enjoy *Everyday Surgery* as it contains a surprising amount of solid material with but very little garnish. However, he will find it in no sense a substitute for the more complete text books. The practitioner who turns to it for help in his everyday problems may be disappointed to find that so little space is given to differential diagnosis and treatment, 2 considerations with which he is very much concerned. Failure to mention sulfanilamide in connection with erysipelas and other streptococcal infections is surprising. Only 11 lines are devoted to surgery of the spleen. It seems the au-

thors are too concise in many instances. Exceptions are the chapters dealing with hernia and anorectal diseases. A wealth of information is concentrated into the short chapter on fractures and dislocations. The illustrations are not numerous but usually adequate, most of them appear to be original drawings. Figure 122 will find many critics. Dr Rogers and Dr d'Aubre state that their objective is an "attempt to present in concise form what we regard as the best in modern surgical practice of an everyday character." In this they have succeeded. If the subject matter is inadequate this is in some measure compensated for by the excellence of its quality.

W. KENNETH JENNINGS

THE English edition of Rouviere's *Anatomy of the Human Lymphatic System*² represents "an attempt to make the publication of scholarly and technical books in small editions pay for themselves through the combination of an inexpensive printing process and definite economies of distribution", the process used is termed "photo lithograph," which apparently is one of many variations of the general method of offset printing.

In the initial chapter which concerns the general characteristics of lymphatic vessels, a great deal of valuable information is provided on the direction of lymphatic flow, on the direct emptying of lymphatic vessels into the venous system at points other than the jugulo subclavian junction, and on the general principles of distribution of lymphatic glands. Beginning with the second chapter not only are the lymphatics of the larger parts considered (extremities, thoracic, and abdominal parietes, etc.) but also the walls of such smaller spaces as the buccal cavity and larynx and such specialized structures as the salivary glands, the gums and teeth, the auditory organ, the liver and its biliary passages, and the nervous system.

For each anatomical region the groups of glands are enumerated and the exact location and arrangement of the several sets discussed. Especially serviceable are the notations as to the relation of the glands to neighboring blood vessels, nerves, and fascial layers, and to the surfaces and margins of muscles. The area of origin of the afferent vessels is described in each instance, as is also the course of efferent vessels between groups of glands. The efferents are traced to the larger trunks and ducts. Variations in the number of lymph glands in each group are discussed fully, as are the retrogressive changes which come with advancing age. Inconstant and rare as well as regularly present groups of glands receive attention. The descriptions of the size and form of prominent individual glands are excellent. This constitutes important information for the careful physician who must know something about quiescent morphology before attempting to judge of pathological enlargement.

¹ *EVERYDAY SURGERY* By Lambert Rogers MSc FRCS FRC SE FRACS FACS and A. L. d'Aubre MSc ChM FRCS With an Introduction by Professor G. Grey Turner DCh MS FRCS FRACS FACS Baltimore: Williams & Wood & Co. 1938

² *ANATOMY OF THE HUMAN LYMPHATIC SYSTEM* By H. Rouvière. A compendium translated from the original *Anatomie des lymphatiques de l'homme* by M. J. Tobias. Ann Arbor: Mich. Edwards Brothers Inc. 1938

The translator with the commendable purpose of simplifying the original treatment has removed to a glossary all special material in which the investigator not the medical student or the practitioner would be interested this material alone of definite value to the research student covers 27 pages. Available too is a superb bibliography of more than 750 titles.

So much then for the contents of the volume but in appraising a book it is essential to distinguish clearly between the products of author and illustrator and the technical means utilized by printer and engraver in making the scholarly wares vendible. In other words contents and format are 2 very different things. The format of the present volume done in modern photo lithography is arresting in an unpleasant manner. To one whose interests have taken him through books from the incunabula to

those of our own day this new work arouses a longing for lithographs that deserve the name and for the velvety excellence of the earlier prints. In the volume under discussion many of the illustrations are so dark that glands and vessels cannot be traced some schematic ones raise more questions than they answer some display the topographical features so confusingly as to present a problem in orientation others are for the bookmaker's convenience uniformly rotated. It is a tribute to our predecessors in the engraving craft that the clearest illustrations in the book are those taken from the works of Mascagni (1823) and Sappey (1874).

The text deserves better handling even though improvement would necessitate raising the selling price in anatomy enigmatic figures which do not illustrate are a poor bargain however low their cost may be.

BARRY ANSON

BOOKS RECEIVED

Books received are acknowledged in this department and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

ANNUAL REPRINT OF THE REPORTS OF THE COUNCIL ON PHARMACY AND CHEMISTRY OF THE AMERICAN MEDICAL ASSOCIATION FOR 1933. Chicago: American Medical Association 1939.

NEW AND NONOFFICIAL REMEDIES 1939. Containing Descriptions of the Articles Which Stand Accepted by the Council on Pharmacy and Chemistry of the American Medical Association on January 1, 1939. Chicago: American Medical Association 1939.

THE ROCKEFELLER FOUNDATION ANNUAL REPORT 1938. New York: The Rockefeller Foundation 1939.

THE SURGERY OF LAIN. By René Fereche M.D. (Lyon) LL.D. (Glasgow) F.R.C.S. (Lond.). Translated and edited by Archibald Young B.Sc. M.B. Ch.B. F.R.F.P.S.C. F.A.C.S. (Hon.) M.D. (Strasbourg). Baltimore: The Williams & Wilkins Co. 1939.

OPERATIVE ORTHOPEDICS. By Willis C. Campbell M.D. St. Louis: The C.V. Mosby Co. 1939.

PLURIFOCAL VASCULAR DISEASES: DIAGNOSIS AND TREATMENT. By William S. Collins B.S. M.D. and Nathan D. Wilensky M.D. Springfield Ill. and Baltimore Md. Charles C. Thomas 1939.

SURGERY OF THE EYE. By Meyer Wiener M.D. and Bennett A. Alvis M.D. Philadelphia and London: W.B. Saunders Co. 1939.

OXFORD MEDICAL PUBLICATIONS. POST MORTEM APPEARANCES. By Joan M. Ross M.D. B.S. (Lond.) M.R.C.S. L.R.C.P. 4th ed. London: Oxford University Press 1939.

BEELEY AND JOHNSTON'S MANUAL OF SURGICAL ANATOMY. Revised by John Bruce M.B. F.R.C.S. (Edin.) and Robert Walsley M.D. 5th ed. London: Oxford University Press 1939.

FUNCTIONAL DISORDERS OF THE FOOT: THEIR DIAGNOSIS AND TREATMENT. By Frank D. Dickson M.D. F.A.C.S. and Ret. L. Dively AB M.D. I.A.C.S. Philadelphia: Montreal and London: J.B. Lippincott Co. 1939.

THE ART OF ANAESTHESIA. By Paul J. Flagg M.D. 6th rev. ed. Philadelphia: London: Montreal: J.B. Lippincott Co. 1939.

LE CANCER DE L'ESTOMAC AU DÉBUT. ÉTUDE CLINIQUE RADIOLOGIQUE ET ANATOMOPATHOLOGIQUE. By René J. Gutmann Ivan Bertrand and Th. J. Penstary. Preface by Dr. A. Gosset. Paris: G. Doin & Cie 1939.

THE TISSUES OF THE BODY: AN INTRODUCTION TO THE STUDY OF ANATOMY. By W. E. Le Gros Clark F.R.S. Oxford: At the Clarendon Press 1939.

THE STORY OF A BABY. Illustrated by the Author. Marie Hall Esq. New York: The Viking Press 1939.

SURGICAL APPLIED ANATOMY. By Sir Frederick Treves Bart. 10th ed. revised by Lambert Rogers M.Sc. F.R.C.S. F.R.C.S.E. F.R.I.C.S. F.A.C.S. Philadelphia: Lea & Febiger 1939.

AN INTRODUCTION TO MODERN GENETICS. By C.H. Waddington Sc.D. New York: The Macmillan Co. 1939.

SCLEROSING THERAPY: THE INJECTION TREATMENT OF HYDRA HYDROCELE VARIKOSE VEINS AND HEMORRHOIDS. Edited by Frank C. Yeomans M.D. F.A.C.S. M.R.S.M. (London Hon.) Baltimore: The Williams & Wilkins Co. 1939.

DISEASES OF THE FOOT. By Emil D.W. Hauser M.D. With a Foreword by Sumner L. Koch M.D. Philadelphia and London: W.B. Saunders Co. 1939.

THE RECTUM AND COLON. By E. Parker Hayden B.S. M.D. F.A.C.S. Philadelphia: Lea & Febiger 1939.

NITROUS OXIDE OXYGEN ANAESTHESIA. NICHESON. CLEMENT VIEWPOINT AND TECHNIQUE. By F.W. Clement M.D. Philadelphia: Lea & Febiger 1939.

SYMPOSIUM ON THE SYNAPSE. By Herbert S. Cassel Joseph Erlanger Detlev W. Bronk Rafael Lorente De No and Alexander Forbes. (Reprinted from *Journal of Neurophysiology* 1939, 2, 362-472.) Springfield Ill. and Baltimore Md. Charles C. Thomas 1939.

STERILITY AND IMPAIRED FERTILITY: PATHOGENESIS, DIAGNOSIS AND TREATMENT. By Cedric Lane Roberts M.S. F.R.C.S. F.R.CO.G. Albert Sharran M.D. M.R.CO.G. Kenneth Walker F.R.C.S. and B.P. Wiesner D.Sc. Ph.D. F.R.S.E. With a Foreword by The Rt. Hon. Lord Horder G.C.I.O. M.D. F.R.C.P. New York: Paul B. Hoeber Inc. 1939.

UNTOWARD EFFECTS OF NITROUS OXIDE ANAESTHESIA WITH PARTICULAR REFERENCE TO RESIDUAL NEUROLOGIC AND PSYCHIATRIC MANIFESTATIONS. By Cyril B. Courtville M.D. With Foreword by Dr. Vandel Henderson. Mount View Calif. Pacific Press Publishing Ass. 1939.

CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

HOWARD C. NAFFZIGER, San Francisco, *President*

GEORGE P. MULLER, Philadelphia, *President Elect*

Committee on Arrangements

THOMAS A. SHALLOW, *Chairman*, L. KRAEER FERGUSON, *Secretary*

COMPLETE PROGRAM FOR THE 1939 CLINICAL CONGRESS

THE complete program for the twenty ninth annual Clinical Congress of the American College of Surgeons, to be held in Philadelphia, October 16 to 20, appears in the following pages. The surgeons of Philadelphia, with excellent facilities at their command for clinical demonstration, have arranged a program of operative and non operative clinics that will be fully worthy of this great medical center with its renowned leaders in medicine and surgery. Five medical schools and more than forty hospitals have co-operated with the committees which have planned the program of clinics and demonstrations which are listed in preliminary form in succeeding pages. The schedules will be revised and enlarged during the weeks preceding the Congress and from day to day thereafter, with daily bulletins being issued at headquarters to show the final schedules. The clinics will be held in the hospitals on Monday afternoon, October 16, and thereafter on both mornings and afternoons of each of the following four days.

Non operative clinics and symposia, which will supplement the varied and extensive schedule of operative clinics, will show the important work being done in special fields in many of the large hospitals. Participating in some of these discussions will be eminent surgeons from other medical centers who, on invitation from the local clinicians, will describe their own methods and experiences. Among the fields in which demonstrations and exhibits have been arranged will be general surgery, genito urinary surgery, neuro surgery, fractures and other traumas, obstetrics and gynecology, broncho esophagology, plastic and faciomaxillary surgery, surgery of the bones and joints, thoracic surgery, ophthalmology, and otorhinolaryngology.

The clinical schedules provided by the hospitals

are being so correlated that the visiting surgeon may be assured of an opportunity to devote his time continuously, if he so desires, to clinics dealing with the special subject in which he is most interested. It is planned to provide adequate morning and afternoon programs for general surgery and the various specialties for each day of the Congress.

It should be pointed out that the clinical program as published in the following pages, and also in the official program to be distributed at the Congress, obviously cannot include all of the detailed information regarding operative clinics and demonstrations scheduled for the several hospitals. A complete detailed program will be provided from day to day, posted in the form of bulletins at headquarters each afternoon for the succeeding day and published in the daily *Bulletin* for distribution each morning. Visiting surgeons are urged to consult the bulletins posted at headquarters and the *Daily Clinical Bulletin* in selecting the clinics they wish to attend and in making requisitions for clinic tickets.

Governors and fellows of the College will hold their annual meetings in the Rose Garden of the Bellevue Stratford Hotel at 1:30 o'clock on Thursday afternoon. At this meeting the officers and chairmen of the standing committees will present reports on activities of the College. Election of officers will follow.

The attention of fellows is especially called to the meeting of three important state and provincial committees to be held on Wednesday in the Palm Garden, on the first floor of the hotel, as follows: Judiciary committees, 9:30 a.m.; Credentials committees, 10 a.m.; Executive committees, 11 a.m. Also of importance is a meeting of the national and regional fracture committees on Thursday afternoon at 4 o'clock in the South Garden.

CLINICAL CONGRESS PROGRAM IN BRIEF

All sessions at the Bellevue Stratford except as noted

Monday, October 16

- 10 00 Hospital Conference—Rose Garden
- 11 00 Assembly of Initiates—Palm Garden
- 2 00 Clinics in Philadelphia Hospitals
- 3 00 Hospital Conference—Rose Garden
- 4 00 Surgical Film Exhibition—Palm Garden
- 5 00 Presidential Meeting and Convocation—Academy of Music

Tuesday, October 17

- 9 00 Clinics in Philadelphia Hospitals
- 9 30 Hospital Conference—Rose Garden
- 10 00 Clinical Demonstrations Ophthalmology—North Garden
- 10 00 Clinical Demonstrations Otorhinolaryngology—South Garden
- 10 00 Surgical Film Exhibition—Palm Garden
- 12 30 Midday Panel Discussions—North Garden South Garden Rose Garden Palm Garden
- 2 00 Clinics in Philadelphia Hospitals
- 2 00 Hospital Conferences—Rose Garden South Garden
- 2 00 Fracture Symposium—Waterspoon Hall
- 2 00 Surgical Film Exhibition—Palm Garden
- 5 00 Scientific Session General Surgery—Irvine Hall
- 8 00 Scientific Session Ophthalmology—North Garden
- 9 00 Scientific Session Otorhinolaryngology—South Garden
- 8 00 Hospital Conference—St. Joseph's Hospital

Wednesday, October 18

- 9 00 Clinics in Philadelphia Hospitals
- 9 30 Hospital Conference—Rose Garden
- 9 30 Judiciary Committee—Palm Garden
- 10 00 Credentials Committee—Palm Garden
- 11 00 Executive Committee—Palm Garden
- 10 00 Clinical Demonstrations Ophthalmology—North Garden
- 10 00 Clinical Demonstrations Otorhinolaryngology—South Garden
- 12 30 Midday Panel Discussions—North Garden South Garden Rose Garden Palm Garden

- 2 00 Clinics in Philadelphia Hospitals
- 2 00 Hospital Demonstrations—Philadelphia Hospitals
- 2 00 Symposium on Cancer—Rose Garden
- 3 00 Surgical Film Exhibition—Palm Garden
- 4 30 Surgical Film Exhibition (ophthalmology and otorhinolaryngology)—Palm Garden
- 8 00 Scientific Session General Surgery—Irvine Hall

Thursday, October 19

- 9 00 Clinics in Philadelphia Hospitals
- 9 30 Hospital Conference—Rose Garden
- 10 00 Clinical Demonstrations Ophthalmology—North Garden
- 10 00 Clinical Demonstrations Otorhinolaryngology—South Garden
- 10 00 Surgical Film Exhibition—Palm Garden
- 12 00 Midday Panel Discussions—North Garden South Garden Palm Garden
- 1 30 Annual Meeting—Rose Garden
- 2 00 Clinics in Philadelphia Hospitals
- 2 00 Hospital Demonstrations—Philadelphia Hospitals
- 3 00 Symposium on Graduate Training—Rose Garden
- 3 30 Surgical Film Exhibition—Palm Garden
- 4 00 National and Regional Fracture Committee—South Garden
- 8 00 Scientific Session General Surgery—Irvine Hall
- 8 00 Scientific Session Ophthalmology—North Garden
- 8 00 Scientific Session Otorhinolaryngology—Rose Garden

Friday, October 20

- 9 00 Clinics in Philadelphia Hospitals
- 10 00 Clinical Demonstrations Ophthalmology—North Garden
- 10 00 Clinical Demonstrations Otorhinolaryngology—South Garden
- 10 00 Surgical Film Exhibition—Palm Garden
- 12 30 Midday Panel Discussions—North Garden South Garden Rose Garden Palm Garden
- 2 00 Symposium on Obstetrics and Gynecology—North Garden
- 2 00 Symposium on Urology—South Garden
- 2 00 Symposium on Diseases of the Respiratory Tract—Rose Garden
- 2 00 Clinics in Philadelphia Hospitals
- 2 00 Surgical Film Exhibition—Palm Garden
- 8 00 Meeting on Health Conservation—Irvine Hall

Surgical motion picture films which so clearly and accurately portray clinical features of major interest to surgeons will again be shown in wide variety and scope including the newer methods in operative technique and pre and postoperative care. There will be an extensive showing of films dealing with subjects related to ophthalmology and otorhinolaryngology. The *Daily Clinical Bulletin* will give the time and place for the showing of these sound and silent films.

SCIENTIFIC SESSIONS

General scientific sessions in the programs for which the Board of Regents has striven to include newer developments in the general and special surgical fields, will be held on Tuesday, Wednesday and Thursday evenings in Irvine Hall at the

University of Pennsylvania. The subjects to be discussed are listed in the detailed programs which will be found on succeeding pages.

The afternoon symposia have been planned to concentrate attention on specific fields of broad interest. Fractures and other traumas will be discussed at the Tuesday afternoon session. Cancer and some of the many problems related thereto will be discussed in a symposium on Wednesday afternoon, a feature of which will be a presentation by Dr. Powman C. Powell, a associate director of the guidance and approval program of the College directed especially toward encouragement of the establishment of cancer clinics in general hospitals. Graduate training for surgery will be the subject of the Thursday afternoon symposium following the annual meeting. Surgical treatment

of diseases of the respiratory tract will be discussed at one of three separate symposia on Friday afternoon the other two being urology, and obstetrics and gynecology.

The midday panel discussions include a number of sessions to be held simultaneously, totaling fifteen separate meetings on four successive days from Tuesday through Friday. The subjects, together with the names of the leaders and collaborators, are listed on a succeeding page. It was necessary to extend these meetings this year because of their demonstrated popularity in the past. The time limit makes concise statement imperative but nevertheless provides opportunity for a 10 minute outline by the chairman, discussion from at least two viewpoints by selected collaborators and question and comment from the audience.

Specialists in ophthalmology and otorhinolaryngology and general surgeons who have an interest in these fields will be attracted by the programs for the series of four scientific sessions on Tuesday and Thursday evenings. One of the Tuesday evening sessions will present a symposium on the Surgical Aspects of Detachment of the Retina the other a symposium on 'Evaluation of Methods of Treatment in Sinusitis'. One of the Thursday evening meetings will be devoted to the consideration of various phases of bronchoesophagology with Dr. Chevalier Jackson as the guest of honor in token of his great achievements in this field.

PRESIDENTIAL MEETING AND CONVOCATION

The usual impressive processional of the officers, regents and honorary guests will open the combined presidential meeting and convocation of the College to be held in the Academy of Music on Monday evening. Welcome will be extended to the assembly by the chairman of the local Committee on Arrangements Dr. Thomas A. Shallow. The guests from abroad will be introduced by Dr. Vernon C. David, vice president. The presidential address will be delivered by Dr. Howard C. Naffziger, the retiring president and the annual oration on surgery by Dr. Everts A. Graham. Other features of this meeting will be the inauguration ceremony for the incoming officers, the presentation of the initiates for fellowship and the awarding of the medical records prize.

ASSEMBLY OF INITIATES

Dr. Howard C. Naffziger, president of the College will preside over and deliver the opening address at the assembly of the 1939 initiates on

Monday morning at 11:00 o'clock in the Palm Garden. Dr. Irvin Abell, vice chairman of the Board of Regents and Associate Director, Bowman C. Crowell and Malcolm I. MacFarnham will discuss briefly the program of the American College of Surgeons. The initiates will then recite the fellowship pledge, following which they will be greeted by Dr. George P. Muller, president elect and Dr. George Crile, chairman of the Board of Regents. The initiates will sign the fellowship roll at the close of the assembly.

OPHTHALMOLOGY AND OTORHINOLARYNGOLOGY

An extensive program of scientific sessions and clinical demonstrations for ophthalmologists and otorhinolaryngologists has been developed. As outlined in the following program, special clinical demonstrations, conducted by local surgeons, will be held at the Bellevue Stratford on Tuesday, Wednesday, Thursday, and Friday mornings. These sessions, held separately for each group, will cover many of the problems of current interest to those who work in these special fields. In the following pages will be found programs for a series of scientific sessions to be held at the headquarters hotel on Tuesday and Thursday evenings, for the presentation and discussion of papers. Operative clinics and demonstrations at the hospitals are scheduled for each day as noted in the clinical program.

CLINICAL DEMONSTRATIONS—OTORHINOLARYNGOLOGY

Tuesday 10:00 a.m.

- WILLIAM HEWSON Operative Indications in Sinusitis
- CARL M. HOUSER The Use of Sulfapyridine in Lung Abscess Following Tonsillectomy
- HENRY A. MILLER Treatment of Sinusitis in Children
- THOMAS F. COWEN Management of Nasopharyngeal Fibromas

Wednesday 10:00 a.m.

- ROBERT H. ILY Pathological Conditions of the Mouth
- GABRIEL TUCKER Diagnosis and Treatment of Laryngeal Tumors Benign and Malignant (color motion picture)
- CHEVALIER L. JACKSON Bronchoscopic Aspects of Bronchial and Pulmonary Tumors
- LOUIS H. CLIFF Pathological Conditions of the Esophagus

Thursday 10:00 a.m.

- Symposium on Chronic Progressive Deafness
- OSCAR V. BYRON Anatomy and Physiology of the Ear
- HARRY P. SCHENCK Thyroxin in the Treatment of Deafness and Tinnitus
- WALTER HUGHSON Surgical Treatment (round window grafts)
- EDWARD H. CAMPBELL Surgical Treatment (labyrinth fistulization)

Friday 10:00 a.m.

- F. HAROLD KRALLS Diagnosis of Lateral Sinus Thrombosis (report of cases)
- HOWARD M. HEBBLER Treatment of Otitis Media and Mastoiditis of Infants and Children with Sulfanilamide

HARRISON F. FLIPPIN Treatment of Pneumococcus Meningitis with Sulfapyridine
 IRVING J. WOLMAN Congenital Stenosis of the Trachea
 (report of a case)

OPHTHALMOLOGY

Tuesday 10:00 a.m.

ROBB McDONALD Dark Adaptation

Wednesday 10:00 a.m.

WALTER I. ILLIE Ludus Chances Associated with Neurosurgical Conditions

Thursday 10:00 a.m.

F. B. SPALTH Bilateral Congenital Colobomas Inner Angle of Lower Lids in a Sister and Brother

Friday 10:00 a.m.

I. S. TASSMAN Use of Contact Lenses Telescopic Spectacles and Other Aids in Cases of Greatly Reduced Vision

GRADUATE TRAINING FOR SURGERY

A symposium on Graduate Training for Surgery will be held at 3 o'clock Thursday afternoon following the annual meeting of the fellows. The program of guidance which the American College of Surgeons has instituted in this field will be discussed by Dr. Dallas B. Phemister of Chicago chairman of the committee under whose sponsorship it has been carried forward. This program has been motivated by the original and primary purpose of the College to elevate the standards of the profession and knowledge of the progress which has been made will be gratifying to the entire fellowship. As a result of personal surveys begun in January 1937 by the field staff of the College information was collected on which to base criteria for evaluating the plans contemplated or already in effect in hospitals. As the surveys have continued the criteria have been applied as a basis for approval and an approved list of hospitals for graduate training in general surgery and the surgical specialties in the United States and Canada was published in the January 1939 *Bulletin* republished with revisions in April and will appear with further revisions in the October issue.

There have also been published in the *Bulletin* since September 1938 descriptions of graduate training plans in effect in 43 hospitals groups of hospitals or medical schools which correlate their graduate training programs with clinical facilities provided in hospitals. These furnish specific details in actual situations which show how the criteria are applied under widely different conditions. In the symposium on graduate training at the Clinical Congress more information will be furnished on how acceptable programs may be developed.

The organization of an educational program will be described by Dr. Willis D. Gatch of Indianapolis. Ensuing discussion of this topic will be led by Dr. George J. Heuer of New York. Supervision of the educational program will be described by Dr. Waltman Walters of Rochester, and the discussion which will follow will be led by Dr. Alton Ochsner of New Orleans. Three different phases of basic science requirements—the basic course research and organized study of surgical pathology—will be discussed by Dr. Walter Fstell Lee of Philadelphia Dr. Alexander Brunswick of Chicago and Dr. Carl H. Leubart of Cleveland respectively followed by general discussion to be led by Dr. Howard C. Naffziger of San Francisco Dr. Walter D. Wise and Dr. Henry F. Bongardt of Baltimore will tell how to evaluate graduate training through records, reports and estimates of work. General discussion of this subject will be led by Dr. Donald Guthrie of Sayre Pa.

All fellows of the College should take advantage of the opportunity afforded by this meeting to obtain and exchange information on this most timely subject. An increasing proportion of the fellowship will as the program advances be directly charged with the supervision preceptorship and guided instruction which must be systematically developed and carried on in hospitals which undertake graduate training for surgery.

HOSPITAL CONFERENCE

The twenty second annual Hospital Standardization Conference will offer the usual full program embracing a wide range of topics related to the hospital care of the patient. Those who attended the conference in the same city three years ago will recall the inspiration furnished by the privilege of inspecting the facilities of one of the country's great hospital centers, number 2 among its institutions the oldest hospital in the United States which is still in existence and will want to renew the experience and observe the progress that has been made in the meantime. Those who have not had the privilege of visiting Philadelphia hospitals before have a memorable experience in store for them. During the four day conference ample opportunity will be provided for independent visits to hospitals in addition to attendance at the special demonstrations which have been arranged for Wednesday and Thursday afternoons. The latter will include a wide variety of procedures and techniques as will be noted from the detailed program which appears on a succeeding page.

The first event on the program for the Hospital

Conference will be an address on "The Hospital Program of the American College of Surgeons," by Dr Howard C Naffziger, of San Francisco, president of the College, at 10 a m on Monday in the Rose Garden of the Bellevue Stratford Hotel. Official announcement by Dr George Crile, chairman of the Board of Regents of the 1939 list of approved hospitals in the United States and Canada will follow. At this session two speakers will discuss the important current topic of graduate training for general surgery and the surgical specialties. Dr Dallas B Phemister, of Chicago, chairman of the American College of Surgeons Committee on Graduate Training for Surgery, will outline trends in this field, and Dr Robin C Buerki, of Chicago, director of study for the Commission on Graduate Medical Education, will discuss "The Role of the Hospital in Graduate Education for the Physician or Surgeon Desirous of Proper Preparation for His Specialty." Other educational aspects of hospital service will be covered by Dr Fred G Carter, of Cleveland, president of the American Hospital Association, whose subject will be "Educated and Trained Personnel Essential for Maintaining Proper Standards of Service in the Care of the Patient" and by James A Hamilton, of New Haven Conn, president of the American College of Hospital Administrators, who will outline the "Essential Qualifications of an Efficient Hospital Administrator." Another topic of absorbing interest, which will be discussed at this session by an able and venerated speaker will be "The Preservation of Our Present Voluntary Hospital System," by Rev A M Schwitalla, S J, of St Louis, president of the Catholic Hospital Association and dean of St Louis University School of Medicine. At the conclusion of the formal discussions, the meeting will be thrown open for questions and comment under the leadership of Dr George P Muller, of Philadelphia, president elect of the American College of Surgeons.

Study of the detailed program for the remainder of the conference, which appears in the following pages, will reveal how much there is in it of potential interest and profit, on subjects of both general and special concern, for members of medical staffs of hospitals, trustees, administrators, and other executive personnel. At some of the sessions, such as those on Monday afternoon and on Thursday morning, a miscellany of topics will be discussed. At others a more limited field will be covered. The Tuesday morning session, for instance, will be given over to a discussion of "The Medical Staff: Its Organization and Function." The subject will first be presented in

general outline, then four speakers will discuss it from certain angles, such as, what actually constitutes a medical staff, proper procedures in extending hospital privileges, making appointments to the medical staff, selection and appointment of chief of medical staff and heads of clinical departments. Control of clinical work through an accounting of professional services will be a final special topic of discussion at this session.

Another special session will be devoted to the general theme, "The Organization and Management of the Small Hospital." This will be held on Tuesday afternoon in the form of a panel round table conference. The standpoints of the importance of the small hospital in certain communities, maintaining competent personnel, medical staff organization, medical records, clinical laboratory and x ray services, nursing, and financing, will be discussed by various speakers. The importance of all small hospitals meeting the minimum requirements of the College will be emphasized.

On Tuesday afternoon, panel discussions on problems pertaining to various phases of hospital administration in the large hospital will be held separately. Among the topics to be presented from this viewpoint will be administrative practices, accounting control and hospital costs, anesthesia, care of emergencies, control of post operative infections from the viewpoints of surgical instruments, hospitalization, and compensation charges.

An evening session on Tuesday in the auditorium of St Joseph's Hospital, is expected to attract a large audience. This will be a round table conference for the discussion of pertinent problems submitted by hospital executives, and will be conducted by Carl I Flath, of Toronto, and Dr Malcolm T MacEachern, of Chicago.

The joint conference of the American College of Surgeons and the American Association of Medical Record Librarians is always an important event on the hospital conference program. It will be held on Wednesday morning at the headquarters hotel under the chairmanship of Dr Robin C Buerki. A review of the present status of medical records in the United States and Canada will be presented by Dr E W Williamson, assistant director of the American College of Surgeons. The president of the Association, Lillian H Erickson, of Chicago, will discuss "The Present Status of the Training of Medical Record Librarians," and other speakers will present various aspects of medical record keeping and utilization. A round table conference on "Medical Record Problems" will conclude the session.

Every year a number of new developments in the mechanical equipment the professional methods and the psychological and public relations aspects of hospitals arise. The hospital executive who attends the Hospital Standardization Conference will find the developments of the past year together with those which have gone before and are still accepted graphically portrayed in the exhibits and motion pictures of interest to hospital people and clearly described in the talks and discussions at the formal sessions panel discussions round table conferences and hospital demonstrations. A stimulating series of meetings is assured and to every hospital is extended an invitation to be well represented at the conference.

ADVANCE REGISTRATION

The hospitals and medical schools of the Philadelphia area afford accommodations for large numbers of visiting surgeons but to insure against overcrowding attendance at the Congress will be limited to the number that can be comfortably accommodated at the clinics. The limit of attendance will be based upon the results of a survey of the operating rooms and laboratories of the hospitals and medical schools to determine their capacity for visitors. It is expected therefore that those surgeons who wish to attend the Congress will register in advance. A registration fee will be required in order to provide funds with which to meet the expenses of the Congress. A formal receipt will be issued to each surgeon registering in advance which is to be exchanged for a general admission card upon his registration at headquarters during the Congress. This card which is not transferable must be presented to secure clinic tickets and admission to scientific sessions.

A resolution adopted by the Board of Regents provides that the registration fee for fellows and endorsed junior candidates shall be \$5.00 that no fee for the 1939 Congress shall be required of initiates (class of 1939) that the fee for non-fellows attending as invited guests of the College will be \$10.00.

As in previous years admission to clinics and demonstrations at the hospitals will be controlled by means of clinic tickets which plan provides an efficient means for the distribution of visiting surgeons at the various clinics and assures against overcrowding. The number of tickets issued for any clinic will be limited to the capacity of the room in which the presentation is held.

HEADQUARTERS—TECHNICAL EXHIBITION

Headquarters for the Congress will be established at the Bellevue Stratford Hotel where there

are unusual facilities for accommodating the Congress. The Ballroom Palm Garden Clover and Red rooms and other large rooms on the first and second floors and the roof have been reserved for scientific exhibits and conferences registration clinic ticket bureaus bulletin boards executive offices etc. Thus the activities of the Congress will be centralized under one roof.

The Technical Exhibition will be located in the Ballroom and adjacent rooms on the second floor. The registration and clinic ticket bureaus together with the registration desk will be centrally located on that floor. The bulletin boards on which the daily clinical programs will be posted each afternoon will be distributed through the exhibit rooms. Leading manufacturers of surgical instruments and supplies x-ray equipment operating room lights hospital apparatus of all kinds ligatures dressings pharmaceuticals and publishers of medical books will be represented.

PHILADELPHIA HOTELS AND THEIR RATES

In addition to the headquarters hotel the Bellevue Stratford there are many first-class hotels within a short walking distance providing ample hotel facilities at reasonable rates. It is suggested that reservation of hotel accommodations be made at an early date at the following hotels which are recommended by the committee.

	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
Adelphi 13th and Chestnut Sts	\$3	85																		
Barclay Rittenhouse Square E	4	50																		
Bellevue Stratford Broad and Walnut Sts	3	85																		
Benjamin Franklin 9th and Chestnut Sts	3	85																		
Colonial 11th and Spruce Sts	2	50																		
Drake 15th Spruce St	4	00																		
Majestic Broad St and Cedar Ave	2	50																		
Philadelphia 19th and Chestnut Sts	2	75																		
Kitz Carlton Broad and Walnut Sts	3	50																		
Robert Morris 17th and Arch Sts	2	50																		
Spruce 13th and Spruce Sts	2	50																		
St James 13th and Walnut Sts	2	75																		
Sylvania Juniper and Locust Sts	3	00																		
Walton Broad and Locust Sts	2	50																		
Warwick 17th and Locust Sts	4	00																		
Wellington 19th and Walnut Sts	4	00																		

RAILROAD FARES

No special rates have been authorized by the railroads for the 1939 Clinical Congress in Philadelphia in accordance with the policy adopted by the railroads of the United States and Canada so that certificates will not be required. However round trip tickets to be sold at less than regular fares will be available from all parts of the United States and Canada except in the New England states where regular rates will be in effect. Return limit provisions are not uniform as to all sections.

of the country, but in no case are they less than 30 days. It is suggested to surgeons planning to attend the Congress that they consult local ticket agents some days in advance of the date of the meeting for complete information as to fares, routes and stopover privileges.

SPECIAL TRAIN FROM CHICAGO TO PHILADELPHIA

For the convenience of the fellows living in the central and western states who will attend the Congress in Philadelphia, arrangements have been made with the Pennsylvania Railroad to provide a special train leaving Chicago from the Union Station (Adams, Jackson and Canal Streets), at 3:30 p.m. (CST) on Sunday, October 15, to

arrive in Philadelphia at 8 a.m. (EST) on Monday. The special train will be composed of air conditioned cars of latest design, including club, lounge, observation, compartment, bedroom, standard sleeping and dining cars. No extra fare will be charged.

Round trip tickets from Chicago to New York, on account of the World's Fair, with stopover at Philadelphia and a 60 day return limit, will be available at special rates.

Fellows are urged to make their reservations for this special train at the earliest possible date, making application to Mr. W. E. Millsbaugh, passenger representative of the Pennsylvania Railroad, Room 1027, 33 N. LaSalle Street, Chicago.

COMMITTEE ON ARRANGEMENTS

EXECUTIVE COMMITTEE

Thomas A. Shallow
Chairman
Lewis K. Ferguson
Secretary
William Bates
W. Emory Burnett
Edward H. Campbell
J. Montgomery Deaver
Everett H. Dickinson
Gilson C. Engel
Theodore R. Fetter
Kenneth E. Fry
Ralph Goldsmith
Francis Grant

Robert H. Ivy
Chevalier L. Jackson
Richard H. Meade, Jr.
Thaddeus L. Montgomery
J. T. Nicholson
John Paul North
Hubley R. Owen
Franklin L. Payne
Warren S. Reese
Frederick R. Robbins
Thomas J. Ryan
Calvin M. Smyth, Jr.
Margaret Sturgis

Germantown—William B. Swartley
Graduate—William Bates, Benjamin H. Shuster, Luther C. Peter, Harry L. Farrell
Hahnemann—Herbert P. Leopold, Frank O. Nagle, John A. Brooke, Newlin F. Paxson
Janes—Roscoe W. Teahan
Jefferson—Thomas A. Shallow, Louis H. Clerf, Charles R. Head
Jewish—Ralph Goldsmith, Philip F. Williams
Kensington—Edward A. Schumann
Lankenau—Gilson C. Engel
Memorial—Bruce L. Fleming
Methodist Episcopal—Calvin M. Smyth, Jr., James B. Mason
Misericordia—Francesco Mogavero
Mt. Sinai—Benjamin Lipshutz
Northeastern—T. Turner Thomas
Northern Liberties—Norman S. Rothschild
Pennsylvania—Walter E. Lee, John B. Flick, F. R. Robbins
Philadelphia General—V. W. Murray, Wright Robert J. Hunter, John C. Howell, I. S. Hneleski
Philadelphia Iyng In—Norris W. Vaux
Philadelphia Orthopedic—DeForest P. Willard
Presbyterian—John Paul North
Preston Retreat—John Cooke Hirst
Joseph I. Rice Memorial—James W. Kennedy
Protestant Episcopal—Richard H. Meade, Jr., Otto C. Hirst, Andrew Knox
St. Christopher's—Harry E. Knox
St. Joseph's—Verne G. Burden
St. Luke's and Children's—Desiderio Roman
St. Mary's—James A. Kelly
St. Vincent's—William F. Morrison
Shriner's—John R. Moore
Stetson—Robert S. Alston
Temple University—W. Wayne Babcock, Walter I. Lillie, Robert F. Ridpath
University of Pennsylvania—I. S. Ravdin, Harry P. Schenck, Francis H. Adler, Franklin L. Payne
U. S. Naval—F. L. Conklin
West Jersey Homeopathic (Camden & J.)—E. S. Haltinger
Wills—Warren S. Reese
Woman's—Margaret Sturgis
Woman's Medical College—Faith S. Fetterman, James A. Lehman
Women's Homeopathic—Francis L. Hughes

SUB COMMITTEES

Broncho Esophagology—Chevalier L. Jackson, Chairman
General Surgery—Hubley R. Owen, Chairman
Genito Urinary Surgery—Theodore R. Fetter, Chairman
Alexander Randall
Industrial Surgery—William Bates, Chairman
Neuro Surgery—Francis Grant, Chairman
Obstetrics and Gynecology—Franklin L. Payne, Chairman
Norris W. Vaux, Thaddeus L. Montgomery
Ophthalmology—Warren S. Reese, Chairman
Orthopedic Surgery—J. T. Nicholson, Chairman
Otorhinolaryngology—Edward H. Campbell, Chairman
Plastic Surgery—Robert H. Ivy, Chairman
Publicity—Kenneth E. Fry, Chairman
J. Montgomery Deaver, Richard H. Meade, Jr.
Thoracic Surgery—W. Emory Burnett, Chairman

HOSPITAL REPRESENTATIVES

Abington—J. Walter Levering
American Hospital for Diseases of the Stomach—Herbert R. Hawthorne
American Oncologic—George M. Dorrance
Broad Street—Theodore C. Geary
Bryn Mawr—J. Stewart Rodman
Chester Hill—William C. Sheehan
Children's—Ernest C. Williamson
Cooper (Camden N. J.)—Irvin E. Deibert
Delaware—Drury Hinton
Fitzgerald Mercy—Thomas J. Ryan
Frankford—Charles I. Nassau

PROGRAMS FOR EVENING SESSIONS

Presidential Meeting and Convocation—Monday, 8 00 p m — Academy of Music

Processional—Officers Regents and Honorary Guests

Invocation

Address of Welcome THOMAS A SHALLOW, M D Philadelphia Chairman Committee on Arrangements

Introduction of Foreign Guests VERNON C DAVID, M D Chicago Vice President

Address of Retiring President HOWARD C NAFFZIGER, M D, San Francisco

Inauguration of Officers Presented by FRASER B GURD, M D Montreal Vice President

President GEORGE P MULLER, M D Philadelphia

First Vice President HENRY W CAVE, M D New York

Second Vice President D EDWIN ROBERTSON, M D Toronto

Presentation of Initiates for Fellowship GEORGE CRILE, M D Cleveland Chairman Board of Regents

Conferring of Fellowships by the President GEORGE P MULLER, M D, Philadelphia

Conferring of Honorary Fellowships The President

Medical Records Prize Award Presented by J BENTLEY SQUIER, M D New York on behalf of SURGERY
GYNECOLOGY AND OBSTETRICS

Annual Oration on Surgery Intrathoracic Tumors ELBERT A GRAHAM, M D St Louis

Tuesday, 8 00 p m — Irvine Hall

The Essential Principles in Clean Wound Healing ALLEN O WHIPPLE, M D, New York

Control of Hemorrhagic Tendencies Including Physiology and Chemistry WALTER WALTERS, M D
Rochester, MinnWater and Salt Requirements in the Postoperative Care FREDERICK A COLLIER, M D Ann Arbor Mich
Vitamin and Protein Factor in the Pre-operative and Postoperative Care of Surgical Patients. EARLE
HOLMES, M D San Francisco*Wednesday, 8 00 p m — Irvine Hall*

Decompression in the Treatment of Intestinal Obstruction CHARLES G JOHNSTON, M D Detroit

Management of Chronic Pelvic Infections GEORGE H CARDNER, M D, Chicago

Conservative Surgery of Bone Tumors DALLAS B PREMISTER, M D Chicago

Fracture Oration The Ambulatory Treatment of Fractures of the Lower Extremity FRASER B GURD
M D Montreal*Thursday, 8 00 p m — Irvine Hall*

The Re-establishment of the Gastric Passage after Resection PROF DR JENO POLYA Budapest Hungary

Duplications of the Alimentary Tract WILLIAM E LADD, M D Boston

Evaluation of Current Methods in the Management of Peptic Ulcer VERNON C HUNT, M D Los Angeles

Operability and Factors which Increase Curability of Malignancy of the Colon and Rectum THOMAS E
JONES, M D Cleveland

ASSEMBLY OF INITIATES

Monday, 11 00 a m — Palm Garden Bellevue Stratford Hotel

Opening Remarks HOWARD C NAFFZIGER, M D San Francisco, President

The Program of the American College of Surgeons

IRVIN ABELL, M D Louisville Vice Chairman Board of Regents

BOWMAN C CROWELL, M D Chicago Associate Director

MALCOLM T MACEachern, M D Chicago Associate Director

The Fellowship Pledge Recital by Initiates

Greetings to the Initiates GEORGE P MULLER, M D Philadelphia President elect

Closing Remarks GEORGE CRILE, M D Cleveland Chairman Board of Regents

Signing of the Fellowship Roll The Initiates

PROGRAMS FOR EVENING SESSIONS

OPHTHALMOLOGY

Tuesday, 8 00 p m —North Garden, Bellevue Stratford Hotel

Symposium Surgical Aspect of Detachment of the Retina

Results of Operations at the Mayo Clinic WILLIAM L. BENEDICT, M D, Rochester, Minn

Results of Operations at the New York Eye and Ear Infirmary CONRAD BERENS, M D, New York

Results of Operations at the Memphis Eye, Ear, Nose and Throat Hospital EDWARD C. ELLETT, M D, Memphis, Tenn

Results of Operations at the Illinois Eye and Ear Infirmary SAMUEL J. MEYER, M D, Chicago

Results of Operations at the Washington University School of Medicine LAWRENCE T. POST, M D and THEODORE E. SANDERS, M D, St. Louis

General Discussion

Thursday, 8 00 p m —North Garden, Bellevue Stratford Hotel

Recent Advances in Plastic Surgery about the Eyes (Technique) VILRAY P. BLAIR, M D, St. Louis

The Technique of Correction of Blepharoptosis DANIEL B. KIRBY, M D, New York

General Discussion

OTORHINOLARYNGOLOGY

Tuesday 8 00 p m —South Garden, Bellevue Stratford Hotel

Symposium Evaluation of Methods of Treatment in Sinusitis

The Indications for Surgical Treatment in Sinusitis FREDERICK T. HILL, M D, Waterville, Maine

The Diagnosis and Surgical Management of Chronic Sinusitis W. RAYMOND MCKENZIE, M D, Baltimore

How and When Shall We Operate upon the Ethmoid Sinuses? WILLIAM MITHOFFER, M D, Cincinnati

Non surgical Therapy in Acute Sinus Disease HENRY B. ORTON, M D, Newark

General Discussion

Thursday 8 00 p m —Rose Garden, Bellevue Stratford Hotel

CHEVALIER JACKSON, M D, Philadelphia, Honor Guest

GEORGE P. MULLER, M D, Philadelphia, President, American College of Surgeons, Presiding

Introductory Remarks GEORGE P. MULLER, M D, Philadelphia

Response CHEVALIER JACKSON, M D, Philadelphia

Present Trends in the Technique of Laryngectomy CHEVALIER JACKSON, M D, Philadelphia

Foreign Bodies in the Air and Food Passages (Observations on End Results in a Series of Nine Hundred Fifty Cases) LOUIS H. CLERF, M D, Philadelphia

Laryngofissure after the Technique of Chevalier Jackson (Observations on Technique and Results in a Series of Over One Hundred Cases) GABRIEL TUCKER, M D, Philadelphia

The Development of Broncho Esophagology CHARLES J. IMPERATORI, M D, New York

The Voice after Laryngeal Operations CHEVALIER L. JACKSON, M D, Philadelphia

MEETING ON HEALTH CONSERVATION

*Friday, 8 00 p m —Irving Hall*GEORGE P. MULLER, M D, Philadelphia, President, American College of Surgeons, Presiding
Surgery—Yesterday and Today GEORGE CRILE, M D, Cleveland, Chairman, Board of Regents

Medical Science Marches On IAVIN ABELL, M D, Louisville, Vice Chairman, Board of Regents

Progress in the Control and Treatment of Cancer JAMES EWING, M D, New York

An Inventory of Your Health FRANK H. LAHEY, M D, Boston

Maternal Welfare JOHN R. FRASER, M D, Montreal

Hospitals Today MALCOLM T. MACEachern, M D, Chicago, Associate Director

PROGRAMS FOR AFTERNOON SESSIONS

SYMPOSIUM ON FRACTURES AND OTHER TRAUMAS

Tuesday 2:00 p.m. — Witherspoon Hall

ROBERT H. KENEDY, M.D., New York, Chairman, Committee on Fractures and Other Traumas, Presiding
An Impartial Evaluation of Several Standard Operations for Hip Reconstruction OTTO J. HERMANN, M.D., Boston

Chest Injuries FRANK B. BERRY, M.D., New York

The Use of Hanging Casts for Fractures of the Shaft of the Humerus JOHN A. CALDWELL, M.D., Cincinnati

Evaluation of the Traction Treatment of Fractures of the Os Calcis JOHN DUNLOP, M.D., Pasadena
Primary and Secondary Tendon Suture MICHAEL L. MASON, M.D., Chicago

SYMPOSIUM ON CANCER

Wednesday 2:00 p.m. — Rose Garden, Bellevue Stratford Hotel

FRANK F. ADAIR, M.D., New York, Chairman, Cancer Committee, Presiding

Radiological Treatment of Cancer of Tongue HAYES E. MARTIN, M.D., New York

Surgical Treatment of Cancer of Tongue LELAND R. COWAN, M.D., Salt Lake City

Surgical Treatment of Cancer of the Thoracic Esophagus JOHN H. GARLOCK, M.D., New York

What Constitute Malignant Tumors of the Nervous System and How to Deal with Them ERNEST SACHS, M.D., St. Louis

Cancer Clinics NORMAN C. CROWELL, M.D., Chicago

Survival Statistics Cancer of the Breast 1925-1935 Jefferson Hospital WILLIAM H. KRAEMER, M.D., Philadelphia

SYMPOSIUM ON GRADUATE TRAINING FOR SURGERY

Thursday 2:00 p.m. — Rose Garden, Bellevue Stratford Hotel

DALLAS B. HUMPHREY, M.D., Chicago, Chairman, Committee on Graduate Training for Surgery, Presiding
Organizing an Educational Program WILLIS D. GATCH, M.D., Indianapolis

Discussion by GEORGE J. HYLER, M.D., New York

Supervision of the Educational Program WALTER W. WALTERS, M.D., Rochester, Minn.

Discussion by ALTON CHAMBERLAIN, M.D., New Orleans

Basic Science Requirement

Basic Course WALTER ESTEIL LEE, M.D., Philadelphia

Research ALEXANDER BRUNSCHWIG, M.D., Chicago

Organized Study of Surgical Pathology CARL H. LESHART, M.D., Cleveland

Discussion by HOWARD C. NAFFZIGER, M.D., San Francisco

Evaluation of Graduate Training—Records, Reports, and Estimates of Work

WALTER D. WISE, M.D., and HENRY F. BONGARDT, M.D., Baltimore

Discussion by DONALD GUTHRIE, M.D., State Pa.

SYMPOSIUM ON UROLOGY

Friday 2:00 p.m. — South Garden, Bellevue Stratford Hotel

End Results in Carcinoma of the Bladder Treated by Radium BENJAMIN S. BARRINGER, M.D., New York

Urologic Aspects of Hypertension DAVID W. MACKENZIE, M.D., Montreal

Perirenal Infections HOMER G. HAMER, M.D., Indianapolis

Some Complications and Dangers of the Lower Ureteral Calculus JOHN K. ORMOND, M.D., Detroit

The Development of Prostatic Hyperplasia CLYDE L. DEMING, M.D., New Haven

SYMPOSIUM ON THE SURGICAL TREATMENT OF DISEASES OF THE RESPIRATORY TRACT

Friday, 2 00 p m — Rose Garden Bellevue Stratford Hotel

- Principles in the Treatment of Empyema WILLARD VAN HAZEL, M D Chicago
 Relationship of Bronchoscopy to Surgery of the Respiratory Tract JOHN D KERNAN, M D, New York
 Surgical Treatment of Pulmonary Abscess GEORGE J HEUER M D, New York
 Curability of Primary Carcinoma of the Lung, Early Recognition and Management RICHARD H OVER
 HOLT, M D, Boston
 Postoperative Pulmonary Complications DANIEL C ELKIN, M D Atlanta

SYMPOSIUM ON OBSTETRICS AND GYNECOLOGY

Friday 2 00 p m — North Garden Bellevue Stratford Hotel

- Some Complications of Pregnancy in which Cesarean Section Is Indicated ARTHUR H BILL M D,
 Cleveland
 The Management of Dystocias of Pregnancy ALFRED C BECK M D, Brooklyn
 Toxemias of Pregnancy HERMAN W JOHNSON M D Houston, Texas
 Prophylaxis and Treatment of Carcinoma of the Cervix and Body of the Uterus WILLARD R COOKE, M D,
 Galveston, Texas
 Endocrine Therapy in Obstetrics and Gynecology JOHN C BURCH, M D, Nashville, Tenn

MIDDAY PANEL DISCUSSIONS

Tuesday 12 30 to 1 45 p m — Bellevue Stratford Hotel

Rose Garden

- Delayed Union and Non Union of Fractures HENRY C MARBLE M D, Boston Presiding
 Collaborators R ARNOLD GRISWOLD, M D Louisville, CLAY RAY MURRAY, M D, New York

South Garden

- Brain Abscess CHARLES BAGLEY JR, M D Baltimore Presiding
 Collaborators C C COLEMAN M D Richmond FRANCIS C GRANT, M D Philadelphia, JOSEPH
 E J KING M D New York

Palm Garden

- Sterilization and Aseptic Operating Room Technique ELIOTT C CUTLER, M D, Boston Presiding
 Collaborators J DERYL HART M D Durham N C FRANK L MELFEX, M D, New York

North Garden

- Pre and Postoperative Drugs Used in Gastro intestinal Surgery IDYS MIMS GAGE M D New Orleans,
 Presiding
 Collaborators ROY D MCCLURE M D Detroit, CHARLES B PUESTOW M D, Chicago, RALPH M
 WATERS M D Madison Wis

Wednesday 12 30 to 1 45 p m — Bellevue Stratford Hotel

Rose Garden

- Biliary Tract Surgery and the Bad Risk Case ARTHUR W ALLEN, M D Boston Presiding
 Collaborators FREDERICK S FOOTE M D, San Francisco CHARLES G JOHNSTON, M D, Detroit,
 I S RAVDIN M D Philadelphia WALTER D WISE M D Baltimore

South Garden

- Treatment of Varicose Veins H O MCPHEETERS M D, Minneapolis Presiding
 Collaborators BEVERLY DOUGLAS M D Nashville HENRY H FAXON, M D Boston, ALTON
 OCHSNER, M D New Orleans, HUGH H TROUT, M D, Roanoke

North Garden

Vitamins and Surgery CHARLES R. ILLSTON, M.D., Chicago, Presiding

Collaborators ALFRED BLALOCK, M.D., Nashville; CHARLES W. MAYO, M.D., Rochester, Minn.

Palm Garden

Some Factors in Blood Irrigation JOHN SCUDDER, M.D., New York, Presiding

Collaborators WILLIAM E. STUDDIFORD, M.D., New York; ELIZABETH H. SCHIRMER, M.D., Chicago; L. KRAEER FERLUSON, M.D., Philadelphia

Thursday 12:00 m to 1:15 p.m. — Bellevue Stratford Hotel

North Garden

Ulcerative Colitis HENRY W. CAVE, M.D., New York, Presiding

Collaborators RICHARD B. CATTELL, M.D., Boston; THOMAS T. MACKIE, M.D., New York; HARVEY B. STONE, M.D., Baltimore

South Garden

The Recognition and Management of Hyperthyroidism GEORGE M. CLYDE, M.D., Columbus, Ohio, Presiding

Collaborators ROY D. McCURE, M.D., Detroit; WARREN H. COLE, M.D., Chicago; HAROLD L. FOSTER, M.D., Danville, Pa.; S. I. LEDBETTER, M.D., Birmingham

Palm Garden

Cooperative Wound Disruption ARTHUR M. SHIPLEY, M.D., Baltimore, Presiding

Collaborators L. S. FALLIS, M.D., Detroit; HILGER PERRY JENNINS, M.D., Chicago; URBAN MAES, M.D., New Orleans

Friday 1:30 to 1:45 p.m. — Bellevue Stratford Hotel

Rose Garden

Analgesia and Anesthesia in Obstetrics HOWARD J. KANE, M.D., Washington, Presiding

Collaborators ARTHUR H. BILL, M.D., Cleveland; THADDEUS I. MONTGOMERY, M.D., Philadelphia

Palm Garden

Postoperative Infections FRANK L. MELENEY, M.D., New York, Presiding

Collaborators MARTIN B. TINKER, M.D., Ithaca; CORNELIUS J. KRAISBL, M.D., New York; JOHN STAKE, DAVIS, M.D., Baltimore; CHAMPEL LIONS, M.D., Boston; JOHN S. LOCKWOOD, M.D., Philadelphia

North Garden

The Management of Cleft Lip and Cleft Palate GEORGE WARREN PIERCE, M.D., San Francisco, Presiding

Collaborators VILRAY I. BLAIR, M.D., St. Louis; V. H. KAZANJIAN, M.D., Boston; EARL C. PADGETT, M.D., Kansas City, Mo.; H. L. D. KIRKHAM, M.D., Houston, Texas

South Garden

Indications for Surgical Treatment of Renal Tuberculosis CILBERT J. THOMAS, M.D., Minneapolis, Presiding

Collaborators HENRY O. MERTZ, M.D., Indianapolis; ALEXANDER RANDALL, M.D., Philadelphia; WILLIAM H. TOULSON, M.D., Baltimore

ANNUAL HOSPITAL STANDARDIZATION CONFERENCE

Monday 10:00 — *Palm Garden, Bellevue Stratford Hotel*
HOWARD C. NAFFZIGER, M.D., San Francisco, President
American College of Surgeons, presiding
Address of President — The Hospital Program of the American College of Surgeons

The 1939 Hospital Standardization Survey — Official Announcement of the List of Approved Hospitals. GEORGE CHILF, M.D., Cleveland, Chairman, Board of Regents

Trend in Graduate Training for Surgery and the Surgical Specialties as Related to Hospitals. DALLAS B. FULMISTER, M.D., Chicago
The Reservation of Our Present Voluntary Hospital System. REY A. M. SCHMITZ, M.D., St. Louis
Educated and Trained Personnel Essential for Maintaining Proper Standards of Service in the Care of the Patient. FRED C. CARTER, M.D., Cleveland

The Role of the Hospital in Graduate Education for the Physician or Surgeon Desirous of Proper Preparation for his Specialty ROBIN C BUEKRI M D Chicago
Essential Qualifications of an Efficient Hospital Administrator JAMES A HAMILTON New Haven Conn
General Discussion Opened by GEORGE P MULLER M D, Philadelphia

Monday 7:00—Rose Garden Bellevue Stratford Hotel
FRASER B GURD M D Montreal Vice President American College of Surgeons presiding
Opening Remarks—Hospital Standardization in Canada FRASER B GURD M D Montreal
The Hospital Trustee and His Proper Conception of Administrative and Professional Practices RAYMOND P SLOAN New York
Responsibility of Elected Public Officials in the Care of the Indigent Sick CLIFFORD CORNELL Clayton Mo
A Study of Nursing Hours in the Care of Various Types of Patients ALBERT H SCHMIDT Chicago
The Significance of Research and Statistics in the Hospital Field ARNOLD F EICH P D Chicago
Relation of Dietary Deficiencies to Surgical Convalescence CHARLES B PUESTOW M D Chicago
Criteria for an Efficient Graduate Nurse, Service with Special Reference to Administrative Policies of the Hospital ALMA H SCOTT R N New York
General Discussion Opened by LEWIS E JARRETT M D Richmond Va

Tuesday 9:30—Rose Garden Bellevue Stratford Hotel
CLAUDE W MUNGER M D New York presiding
General Theme The Medical Staff Its Organization and Function
The Importance of an Efficient Medical Staff to a Hospital LUGENE WALKER M D Springfield Mass
Discussion from the standpoints of
What Constitutes a Medical Staff? OSWALD H ANDERSON M D St Louis
The Right of the Governing Board of the Hospital to Appoint the Medical Staff JOSEPH C DOANE M D Philadelphia
Proper Procedure to Follow When Extending Hospital Privileges and Making Appointments to the Medical Staff CHARLES H YOUNG M D Montclair N J
Selection and Appointment of Chief of Staff and Heads of Departments in Relation to Hospital Management JESSIE J TURNBULL R N Pittsburgh
Accounting of Professional Services as a Means of Controlling Clinical Work THOMAS R PONTON M D Chicago
General Discussion Opened by JOE R CLEMONS M D New York

Tuesday 11:00—Rose Garden Bellevue Stratford Hotel
Panel Round Table Discussion Problems Pertaining to Various Phases of Hospital Administration in the Large Hospital Conducted by WILLIAM M ALLEN M D Hartford Conn
Administration Maintaining good morale among hospital personnel admitting and discharging procedure responsibility for scientific work conferences of administrator with heads of departments FRANK B GAIL Camden N J
Accounting Control and Hospital Costs Budget—pre determined costs control of purchases personnel day by day control issuance of food medical supplies etc total costs functional costs per capita costs (in and out patients) GORDON T BROAD New York

Anesthesia Essentials of a properly organized department responsibility for selection of type of anesthetic to be used pre anesthetic examination of patient elimination of anesthetic hazards MILTON C PETERS M D New York

Emergencies Organization of emergency services, shock hemorrhage and poisoning blood transfusion emergency lighting in the hospital JOHN M T FINNEY JR M D Baltimore

Control of Postoperative Infections from the Standpoint of Surgical Instruments Unsterilized versus sterilized instruments technique for cleansing and sterilizing surgical instruments decreased inventory of surgical instruments labor saving and other factors in post operative infections CARL W WALTER M D Boston
Hospitalization and Compensation Charges For hospitalization patients for compensation or insurance patients uniform charges co operative action among hospitals NORA E YOUNG, R N, Brooklyn

Tuesday 1:00—South Garden Bellevue Stratford Hotel
Panel Round Table Discussion General Theme The Organization and Management of the Small Hospital Conducted by CARL J FLATH Toronto
The Importance of the Small Hospital in Certain Communities CHARLES A INQUIST Elgin Ill
Discussion from the following viewpoints

Personnel Securing adequate personnel minimizing turnover maintaining good morale training hospital personnel MILDRED WALKER Wauseon Ohio
Medical Staff Organization Selecting and organizing the medical staff controlling the clinical work conducting medical staff conferences HUSTON K SPANGLER M D Chicago

Medical Records Securing medical records filing and preserving medical records using medical records JAMES H SPENCER JR M D, Franklin N J

Clinical Laboratory Service Providing adequate service maintaining competent technical services supervision and financing the clinical laboratory LALL G MONTGOMERY M D Muncie Ind

X-ray Service Providing adequate service maintaining competent technical services supervising and financing the x-ray department DAVID M CALDWELL, M D Manchester Conn

Nursing Service Providing adequate service supplementing nursing service with attendants or subsidiary workers determining personnel requirements maintaining permanency in personnel EDNA D PRICE R N Concord Mass

Financing Assuring accounting efficiency utilizing all sources of revenue collecting delinquent accounts stimulating philanthropic endeavor O K FIFE Richmond Va

Tuesday 8:00 p.m.—St Joseph's Hospital
Round Table Conference—Presentation and Discussion of Pertinent Hospital Problems Submitted by Hospital Executives Conducted by MALCOLM T MACEACHERN, M D Chicago

Wednesday 9:30—Rose Garden Bellevue Stratford Hotel
Joint Conference with American Association of Medical Record Librarians ROBIN C BUEKRI M D Chicago presiding
A Preview of the Present Status of Medical Records in the United States and Canada as seen by the American College of Surgeons EARL W WILLIAMSON M D Chicago

North Garden

Vitamins and Surgery CHARLES B. PLESTON, M.D., Chicago, Presiding

Collaborators: ALFRED BLALOCK, M.D., Nashville; CHARLES W. MAYO, M.D., Rochester, Minn.

Palm Garden

Some Factors in Blood Preservation JOHN SCUDDER, M.D., New York, Presiding

Collaborators: WILLIAM C. STUDDIFORD, M.D., New York; ELIZABETH H. SCHIRMER, M.D., Chicago; L. KRAEER FERGUSON, M.D., Philadelphia

Thursday 12:00 m to 1:15 p.m. — Bellevue Stratford Hotel

North Garden

Ulcerative Colitis HENRY W. CAVE, M.D., New York, Presiding

Collaborators: RICHARD B. CATTELL, M.D., Boston; THOMAS T. MACKIE, M.D., New York; HARRY B. STONE, M.D., Baltimore

South Garden

The Recognition and Management of Hyperthyroidism GEORGE M. CURTIS, M.D., Columbus, Ohio, Presiding

Collaborators: ROY D. McCLURE, M.D., Detroit; WARREN H. COLE, M.D., Chicago; HAROLD L. FOSTER, M.D., Danville, Va.; S. L. LEDBETTER, M.D., Birmingham

Palm Garden

Isoperative Wound Disruption ARTHUR M. SHIPLEY, M.D., Baltimore, Presiding

Collaborators: L. S. FALLIS, M.D., Detroit; HILGER PEPPY JENKINS, M.D., Chicago; URBAN MAES, M.D., New Orleans

Friday 1:30 to 1:45 p.m. — Bellevue Stratford Hotel

Rose Garden

Analgesia and Anesthesia in Obstetrics HOWARD F. KANE, M.D., Washington, Presiding

Collaborators: ARTHUR H. BILL, M.D., Cleveland; THADDEUS L. MONTGOMERY, M.D., Philadelphia

Palm Garden

Postoperative Infections FRANK L. MELLENEY, M.D., New York, Presiding

Collaborators: MARTIN B. TINKER, M.D., Ithaca; CORNELIUS J. KRAISSL, M.D., New York; JOHN STAGGE DAVIS, M.D., Baltimore; CLAUDE LYONS, M.D., Boston; JOHN S. LOCKWOOD, M.D., Philadelphia

North Garden

The Management of Cleft Lip and Cleft Palate GEORGE WARREN FIEBLE, M.D., San Francisco, Presiding

Collaborators: VILRAY F. BLAIR, M.D., St. Louis; V. H. KAZANJIAN, M.D., Boston; EARL C. PADGETT, M.D., Kansas City, Mo.; H. L. D. KIRKHAM, M.D., Houston, Texas

South Garden

Indications for Surgical Treatment of Renal Tuberculosis GILBERT J. THOMAS, M.D., Minneapolis, Presiding

Collaborators: HENRY O. MERTZ, M.D., Indianapolis; ALEXANDER RANDALL, M.D., Philadelphia; WILLIAM H. TOLSON, M.D., Baltimore

ANNUAL HOSPITAL STANDARDIZATION CONFERENCE

Monday 10:00 — Rose Garden, Bellevue Stratford Hotel
HOWARD C. NAFFZIGER, M.D., San Francisco, President

American College of Surgeons, presiding
Address of President — The Hospital Program of the American College of Surgeons

The 1939 Hospital Standardization Survey — Official Announcement of the List of Approved Hospitals GEORGE CRILE, M.D., Cleveland, Chairman, Board of Regents

Trends in Graduate Training for Surgery and the Surgical Specialties as Related to Hospitals DALLA B. LUTHER, M.D., Chicago

The Preservation of Our Present Voluntary Hospital System REV. A. M. SCHWITALLA, S.J., St. Louis
Educated and Trained Personnel Essential for Maintaining Proper Standards of Service in the Care of the Patient FRED G. CARTER, M.D., Cleveland

PRELIMINARY CLINICAL PROGRAM

ARRANGED IN THE FOLLOWING SUBDIVISIONS GENERAL SURGERY, OBSTETRICS AND GYNECOLOGY, SURGERY OF BONES AND JOINTS, GENITO URINARY SURGERY, FRACTURES AND OTHER TRAUMAS, NEUROSURGERY, THORACIC SURGERY, PLASTIC AND FACIO-MAXILLARY SURGERY, BRONCHO ESOPHAGOGY, OTORHINOLARYNGOLOGY, OPHTHALMOLOGY

GENERAL SURGERY

Monday

HOSPITAL FOR DISEASES OF STOMACH

FRANCIS A. MANTZ—1 Operative and dry clinic

FITZGERSON HOSPITAL

ROBERT LAYTON and SHERMAN EGER—11 Varicose veins
J. HALL ALLEN and BENJAMIN HASKELL—1 30 Lesions of the anus and rectum

HENRY K. MOHLER—2 Therapeutics in surgery

MOUNT SINAI HOSPITAL

MOSES BEHREND and staff—1 15 Operations

PENNSYLVANIA HOSPITAL

ORVILLE C. KING—2 Spinal anesthesia
GARFIELD C. DUNCAN—3 Management of diabetes during acute infections and surgical complications
SAMUEL BRADBURY—4 Surgical follow up and group practice

PHILADELPHIA GENERAL HOSPITAL

HUBLEY R. OWEN JOHN PAUL NORTH and LEWIS C. MANOES—1 30 Operative and dry clinic
JOSEPH McFARLAND and staff—2 Radiological clinic
Diagnosis of new cases review of old cases and group discussion

RUBIN M. LEWIS and staff—3 30 Treatment of varicose veins and their complications

I. S. HNELESKI and ELEANOR VALENTINE—3 Management of blood bank at the Philadelphia General Hospital demonstration of apparatus technique of venesection and transfusion and laboratory studies on refrigerated blood

ST JOSEPH'S HOSPITAL

EDWARD A. MALLON Daily—historical exhibit commemorating the ninetieth anniversary of St. Joseph's Hospital

STETSON HOSPITAL

ROBERT S. ALSTON and C. E. SCHWARTZ—2 Operations
CARL F. KOENIG—2 X-ray clinic

TEMPLE UNIVERSITY HOSPITAL

WILLIAM A. STIFFEL and C. HOWARD McDEVITT—2 Dry clinic General and emergency surgery
HARRY Z. HIBSHMAN HARRY F. BACON and staff—3 Proctology Operative and dry clinic
CARROLL S. WRIGHT—3 Dermatology and syphilology

WEST JERSEY HOMEOPATHIC HOSPITAL

II WESLEY JACK and staff—9 Operations Cholecystectomy

Tuesday

ABINGTON MEMORIAL HOSPITAL

JOHN ELMAN—2 Chemical problems in surgery

AMERICAN ONCOLOGIC HOSPITAL

GEORGE M. DORRANCE JOHN W. BRANSFIELD and FREDERICK A. BOTHE—10 Operative and dry clinic Cancer of rectum

JOSEPH McFARLAND—11 Pathological demonstration Cancer of rectum

BRYN MAWR HOSPITAL

JOHN B. GLICK and FREDERICK R. ROBBINS—9 Operations

MAX STRUMIA—2 Surgical pathology (Blood pictures in surgical infections with special emphasis on neutrophils)

CHESTNUT HILL HOSPITAL

JOHN F. McCLOSKEY JAMES A. LEHMAN J. M. ELLZEY JR. and JOHN J. SHOBER—10 Operations

CHILDREN'S HOSPITAL

ORVILLE KING—11 Splenomegaly in children

FITZGERALD MERCY HOSPITAL

JAMES A. KELLY—9 Operations
THOMAS J. RYAN—9 Operations

FRANKFORD HOSPITAL

RALPH W. LORRY Operative and dry clinic

GERMANTOWN HOSPITAL

EDWARD B. HODGE WILLIAM B. SWARTLEY ROBERT S. ALSTON STEPHEN D. WEEDER and HANS MAY—10 Operations

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

WILLIAM BATES—9 Dry clinic Parietal neuralgia
JOHN C. HOWELL and I. I. GOPADZE—11 Operations Dry clinic Treatment of so called subacromial bursitis

HAHNEMANN HOSPITAL

A. B. WEBSTER—9 Operations

HOSPITAL FOR DISEASES OF STOMACH

HENRY R. HAWTHORNE WILBUR W. OAKS and PAUL H. NEFSE—9 Operative and dry clinic

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

I. S. RAVDIN and staff—9 Biliary tract operations
J. F. RHODES The management of the hemorrhagic tendency of obstructive jaundice
I. S. RAVDIN The relation of diet to liver injury
W. D. FRAZIER The control of the external loss of bile
H. P. ROYSTER Visualization of the common bile duct
O. V. BATSON Incisions for biliary tract operations
IVAN TAYLOR Anesthesia in biliary tract operations
I. S. RAVDIN Find results in biliary tract surgery

The Present Status of the Training of Medical Record Librarians LILLIA H. FRICKSON R.R. Chicago
Difficulties in Securing Good Medical Records in the Small Hospital and How to Overcome Them GENEVIEVE HILLER R.R. Decorah Iowa

The Place of the Medical Secretary in the Hospital RUTH HESS Bluefield W. Va.

Overcoming Problems Incident to Securing Acceptable Specialty Medical Records RAY K. DAILY M.D. Houston Texas

Legal Aspects of Medical Record HENRY H. CULWELL Chicago

Round Table Conference—Medical Record Problems Conducted by W. FRANKLIN WOOD M.D. Waverley Mass.

Wednesday—Demonstration in Local Hospitals
Children's Hospital SUSAN C. FRANCIS R.N. Superintendent

Pediatric Nursing Care and Isolation Precautions
Infantile Eczema DONALD M. PILLSBURY M.D.
Children in Chapple Cabinet Lubricates CHARLES C. CHAPMAN M.D.

Administration of Blood Transfusions to Infants ALICE L. McLENNAN M.D.
Procedure and Technique in Making Up Infant Feedings—Milk Laboratory AGNES H. ADDAMS and IRENE SALLAN

(Graduate Hospital) of the University of Pennsylvania DONALD C. SMILEY M.D. Director

Organization and Management of a Blood Bank FRANK JONES M.D. MELBA FIMBUSH and MARILYN L. LEWIS

Preparation of Parenteral Solutions ALEXANDER KELSER and MARJORIE HOPPEL

Technique of Preparation and Administration of Parenteral Solution FRANK JONES M.D. and JOSEPHINE LAMBROTH

Hospital of the University of Pennsylvania MARY A. STEPHENSON Superintendent

Central Dressing Room Control of Supplies Sterilization in Dressings and Supplies Tray Set-ups etc. CLAYTON CHAMBERLAIN R.N.

Pediatric Bedside Clinics Demonstration of Pediatric Nursing Technique LILLIAN CRAN R.N.

Use of the Outpatient Department in Teaching of the Student Nurse—Case Reports on Bilateral Drainage of the Miller Abdominal Tube KENNETH A. ELSON M.D. and FRANCES SAGE R.N.

Resuscitation and Oxygen Therapy from the Physicians and Nurses Viewpoint IRVING B. TAYLOR M.D. and FREDERICK H. SCOTT R.N.

The Nurse's Responsibility in Wound Suction Drainage EVELYN FARRAND R.N.

Indirect Blood Transfusions Use of Blood Banks EVELYN FARRAND R.N.

Venoclysis Procedure Set-up Solution Nursing EVELYN FARRAND R.N.

Demonstration of Vacillator Bed MARY C. WENRICH R.N.

Laurenau Hospital ROBERT SHOEMAKER 3rd M.D. Executive Medical Officer

Organization and Management of Medical Records Department CASSON C. JACOB M.D. and staff

Follow up and Study of End Results STANLEY P. REIMANN M.D. and staff

United States Naval Hospital Captain HENRY L. DOLAN M.D. Commanding Officer

Physical Therapy Lieutenant CARL K. JOHNSON

Jefferson Medical College Hospital ROBERT B. AYE M.D. Medical Director

Organization Management and Clinic Method—Curt Clinic ROBERT B. AYE M.D. and HARVARD R. HARRICK M.D.

Thursday 9:30—Kore Garden Bellevue Stratford Hotel

DONALD C. SMILEY M.D. Philadelphia presiding

Interference with Radio Reception Caused by Hospital Medical Equipment H. B. WILLIAMS M.D. New York

Organization and Operating Problems of a Tumor Unit in a General Hospital JOSEPH TENOPPE M.D. Brooklyn

Principles of Relationship Between Radiologists and Hospitals H. R. KIRKLIN M.D. Rochester Minn.

Principles of Relationship Between Pathologists and Hospitals FRANK HARTMAN M.D. Detroit

Principles of Relationship Between Anesthetists and Hospitals LEROY J. ROSENSTEIN M.D. New York

General Discussion Opened by BASIL C. MACLEAN M.D. Rochester N.Y.

Thursday 10:00—Demonstrations in Local Hospitals

Jennymania Hospital (Woman's Building) NORMA W. VACK M.D. Obstetrician and Gynecologist in Chief

Maternal Care Obstetrical Technique and Procedure Admission of Patient and Assignment to Accommodation Sportswood ROBERT M.D.

Internal Case J. VERNON LILSON M.D.

Special Clinics CRAIG WRIGHT MICALLE M.D.

Preparation of Patient ROBERT M. SMITH M.D.

Observation of Patient in Labor ROSS B. WILSON M.D.

Delivery Room Set-up Obstetrical Technique and Procedures CLIFFORD B. FULL M.D.

Care of the Patient Immediately Postpartum JOHN C. VILLEY M.D.

Care of the Patient Throughout Puerperium While in the Hospital ROBERT J. KIRKWOOD M.D.

Follow up and End Results F. SIMPLY DUNNE M.D.

Out Patient Clinic PENNSYLVANIA TRUPKINS M.D.

Care of the Newborn RUTH M. TYSON M.D.

Pennsylvania Hospital JOHN A. HATFIELD Administrator for Food Service MARGARET J. BENNETT

Philadelphia General Hospital WILLIAM G. TERRELL M.D. Superintendent

Organization and Management of a Blood Bank I. S. HANSSON M.D.

Nursing Technique SCRIPPA M. JOHNSON R.N.

Wills Hospital STEVE WIERZBICKI Superintendent

Development of Consultation Clinics in Specialty Hospitals JOSEPH V. KLARDER M.D. and WILLIAM FRANCIS WHELAN M.D.

Nursing and Operating Room Technique in an Eye Hospital CLAYTON COLL and HELEN E. MILLER

Wednesday

ABINGTON MEMORIAL HOSPITAL

DAMON B PFEIFFER J WALTER LEVERING and J M DEAVER—2 Operations

BROAD STREET HOSPITAL

A B WEBSTER and T C GEARY—10 Operations

BRYN MAWR HOSPITAL

ARTHUR E BILLINGS and CHARLES H HARVEY—9 Operations

CHESTNUT HILL HOSPITAL

WILLIAM B SWARTLEY S DANA WEEDE EDWARD F McLAUGHLIN and WILLIAM SWARTLEY RINKER—10 30 Operations

COOPER HOSPITAL

PAUL M MECRAY I E DEIBERT F W SHAVER and R S GAMON—9 Operative and dry clinic Abdominal and thoracic surgery empyema

DELAWARE COUNTY HOSPITAL

DRURY HINTON and C A STEINER—9 Operative and dry clinic

FITZGERALD MERCY HOSPITAL

BASIL R BELTRAN—9 Operations
ALEXANDER E BURKE—9 Operations

FRANKFORD HOSPITAL

BENJAMIN H CHANDLER—9 Operations

GERMANTOWN HOSPITAL

CHARLES F MITCHELL WALTER E LEE HARRY E KNOX and THOMAS M DOWNS—10 Operations

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

GEORGE M PIERSON GEORGE C GRIFFITH and WALTER E LEE—9 Dry clinic Calcified constrictive pericarditis medical and surgical aspects

JOSEPH T BEARDWOOD Jr JOSEPH C YASKIN and WALTER E LEE—10 Symposium on cancer Pancreatic adenoma with hyperinsulinism metabolic neurological and surgical aspects

WALTER E LEE HARRY FARRELL, JONATHAN RHOADS and NORMAN E FREEMAN—11 Operative and dry clinic Constrictive pericarditis

COLLIER F MARTIN—2 Lymphogranuloma venereum

HAHNEMANN HOSPITAL

G A VAN LENNEP—9 Operations

HOSPITAL FOR DISEASES OF STOMACH

SHERMAN A EGER—9 Operative and dry clinic
HERBERT R HAWTHORNE WILBUR W OAKS and PAUL H NEESE—12 Operative and dry clinic

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

E L ELIASON and staff—9 Operations Biliary surgery
JULIAN JOHNSON Management of acute cholecystitis
ROBERT B BROWN Hazards of cholecystectomy
WILLIAM H ERB Pancreatitis and gall bladder disease
F L ELIASON Surgical jaundice
LLOYD W STEVENS Biliary fistula

I S RAVDIN and staff—2 Dry clinic on pre and post operative care

NORMAN E FREEMAN The management of surgical shock

FRANCIS WOOD The heart in surgical patients
H C BAZETT The effect of climatic conditions on blood volume

J H GIBBON Jr The problem of embolus in surgical patients

J E RHOADS The use of sulfanilamide in spreading peritonitis

S GOLDSCHMIDT The danger of anoxemia during surgical operations

J S LOCKWOOD The mode of action of sulfanilamide and related compounds

NORMAN E FREEMAN Some observations on peripheral vascular disease

I S RAVDIN The effect of recent advances of pre and postoperative treatment on the morbidity and mortality of surgical operations

L K FERGUSON PAUL LOEFFELD WILLIAM H ERB LOUIS KAPLAN and NORMAN E FREEMAN—2 Treatment of varicose veins and ulcers injection treatment of varicose veins indications for and technique of ligation in the treatment of varicose veins treatment of varicose ulcers treatment of painful arteriosclerotic ulcers

JEFFERSON HOSPITAL

GEORGE P MULLER and staff—9 Dry clinic

ADOLPH A WALKLING Cholangiography

GEORGE P MULLER Subtotal gastrectomy

JAMES SURVER Carcinoma of breast tumor clinic follow up study over a 10 year period

GEORGE P MULLER and staff—11 Operations

ROBERT LAYTON and SHERMAN EGER—11 Varicose vein clinic

J HALL ALLEN and BENJAMIN HASKELL—1 30 Lesions of the anus and rectum

THOMAS A SHALLOW—2 Operations Colon and rectum

WILLIAM S NEWCOMET—4 Dry clinic Cases of angioma showing results of various methods of treatment

JEWISH HOSPITAL

RALPH GOLDSMITH—9 Operations

MOSES BEHREND—2 Operations

LANKENAU HOSPITAL

GEORGE P MULLER GILSON C ENGEL JOSEPH O KEEZEL and HANS MAY—9 Operations

STANLEY P REIMAN and staff—11 Studies from clinical and research laboratory upon cancer growth etc

GILSON C ENGEL and HANS MAY—11 Fractures of the neck of the femur treatment and pathology with general discussion

MEMORIAL HOSPITAL

BRUCE L FLEMING—9 Operations

METHODIST EPISCOPAL HOSPITAL

GEORGE J SCHWARTZ and staff—10 Operations

MISERICORDIA HOSPITAL

JAMES A KELLY and D C GEIST—9 Operations

NORTHERN LIBERTIES HOSPITAL

BYRON GOLDSMITH and MORRIS SEGAL—9 Operative clinic

PENNSYLVANIA HOSPITAL

ALLAN BISHOP—2 Dry Clinic Acute intestinal obstruction with x ray diagnosis and special reference to the Abbott tube

WILLIAM A WOLFF and RUSSELL L LANTON—4 Dry Clinic Chemical control of surgical patients

PHILADELPHIA CENTRAL HOSPITAL

W WAYNE BARCOCK—9 Dry clinic

WILLIAM T LEMMON—9 Operative clinic Gall bladder disease

JOHN O BOWER JOHN C BURNS and HARRY B TRACHTENBERG—9 Demonstration of use of very fine size calicut in gastric intestinal surgery management of preadix peritonitis due to perforated appendix with special reference to the use of convalescent hypophysectomy

HENRY S RUTH—11 Choice of anesthetics in surgery

I S HANDELSON and FLEOR VALENTINE—3 Management of blood bank at the Philadelphia Central Hospital demonstration of apparatus technique of venesection and transfusion and laboratory studies on refrigerated blood

PRESBYTERIAN HOSPITAL

WILLIAM BATES JAMES B MASON and JOHN C HOWELL—9 Dry clinic Pseudo abdominal lesions

PROTESTANT EPISCOPAL HOSPITAL

Staff—9 Dry clinic

M L LEE—9 X ray therapy of inflammation

I M BOYKIN Problems in gall bladder surgery

R L LAYTON Amputation in diabetic gangrene

R H MFADE Jr Acute hemorrhagic pancreatitis

ST JOSEPH'S HOSPITAL

S D SPOTTS—9 Operations

CHARLES F NASSAL—10 Operations

I A SOLOFF—3 Laboratory demonstration of surgical pathology

ST LUKE'S AND CHILDREN'S HOSPITAL

DESIDERIO ROMAN R W LAKER H K ROESSLER A W HAMMER and staff—9 Operative clinic

J W LOST—9 Roentgenological examinations

O F BARTHAUME—9 Demonstration Pathological and bacteriological examinations

ST MARY'S HOSPITAL

A P KEEGAN—9 Operations

STFTSON HOSPITAL

WILLIAM T ELLIS and J A MARAS—12 Operations

CARL E KOENIG—2 X ray clinic

ROBERT S ALSTON and C F SCHWARTZ—2 Operations

TEMPLE UNIVERSITY HOSPITAL

W WAYNE BARCOCK C MASON ASTLEY W EMORY BURNETT and J NORMAN COOMBS—9 Operations

W EDWARD CHAMBERLAIN and staff—9 Radiological clinic

WILLIAM A STEEL and C HOWARD McDEVITT—2 General and emergency surgery

HARRY Z HISHMAN HARRY F BACON and staff—3 Operative and dry clinic

U S NAVAL HOSPITAL

F L CONKLIN W T LINDBERRY and H L PUGH—9 Operations

J J WHITE—9 Demonstration Kettering Simpson hypertherm

J J WHITE—1 Demonstration Kettering Simpson hypertherm

C A YOCAGLIA—2 Demonstration Physical therapy

C J MORRISON—2 Demonstration Spinalograms

WOMEN'S HOMOPATHIC HOSPITAL

R W FARRE—9 Operations

C F SHOLLENFRÖGER—1 Operations

Thursday

WASHINGTON MEMORIAL HOSPITAL

DAVID B FELIPPER J WALTER LEVERING I M BOYKIN

J M DEASER and staff—2 Dry clinic Peptic ulcer and its surgical complications

BRYN MAWR HOSPITAL

RAEHL S BROMER—9 X ray conference Diseases of bone

J STEWART KIDMAN and ALAN T PARRIS—9 30 Operations

CHESTNUT HILL HOSPITAL

WILLIAM C SHEEHAN L H HERGESHEIMER HANS VAN

AND H P MACFARLAN—10 Operations

FAY K ALFAANDER—11 Intra abdominal tumor x ray studies

CHILDREN'S HOSPITAL

WALTER F LEE and JEFFERICK ROBBINS—11 Operations and ward rounds Surgery in children

COOPER HOSPITAL

PALL M MECKAY I E DEIBERT F W SNITZER and

R S CANON—9 Operative and dry clinic General surgery fractures carcinoma of breast

FITZGERALD MERCY HOSPITAL

JAMES A KELLY—9 Operations

THOMAS J RYAN—9 Operations

FRANKFORD HOSPITAL

CHARLES F NASSAL—9 Operations

GERMANTOWN HOSPITAL

EDWARD B HODGE WILLIAM B SWARTLEY ROBERT S

ALSTON STEPHEN D WELDER and HANS MAY—10 Operations

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

HERBERT F RANTHORNE—9 Operations

HARRISBURG HOSPITAL

WILLIAM L SYLVE—9 Operations

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

I S RAVID and staff—9 Gastro-intestinal operation

I S RAVID The effect of nutritional edema on failure of stomach to empty

ALFRED STENDEL JR Nutrition in gastro-intestinal cases

W D THOMPSON JR Factors conditioning wound healing in surgical patients

W O ABERG The use of the Miller Abbott tube in acute intestinal obstruction

W D FRAZIER Indications for operation in patients with gastric or duodenal ulcer

JEFFERSON HOSPITAL

- KENNETH L. FRI—9 Peritoneoscopy as a diagnostic and in surgery
 THOMAS A. SHALLOW and staff—10 Operations
 HOBART A. REIMANN—2 Medico surgical problems
 J. HALL ALLEN and BENJAMIN HASKELL—3 Proctological operations

JEANES HOSPITAL

- ROSCOE M. TEAHAN, HOPE WAMMOCK, and CLARENCE A. WHITCOMB—9 Operations Abdominoperineal resection of rectum excision of carcinoma of bladder in plantation of radon for carcinoma of mouth
 Staff—11 Dry clinic
 W. S. HASTINGS A review of proposed methods of serological diagnosis of cancer
 A. M. DUFF JR. The rapid diagnosis of fresh tissue
 HOPE WAMMOCK The control of pain of advanced cancer with irradiation
 C. A. WHITCOMB Presentation of treated oral lesion

JEWISH HOSPITAL

- IRANK B. BLOCK—9 Operations

LINKENAU HOSPITAL

- DAMON B. PFEIFFER, J. MONTGOMERY DEANER and ALBERT MARTIN—9 Operations Discussion of cancer of rectum with report of cases

METHODIST EPISCOPAL HOSPITAL

- CALVIN M. SMITH JR. and staff—9 Operations

MISI RICORDIA HOSPITAL

- B. R. BELTRAN and E. GARVIN—9 Operations
 GEORGE P. MULLER, F. MCGAVERO and F. T. MCGINNIS—9 Operations

MOUNT SINAI HOSPITAL

- BENJAMIN LIP WITZ and staff—9 Operations

PENNSYLVANIA HOSPITAL

- WALTER E. LEE and staff—9 Operative and dry clinic

PHILADELPHIA GENERAL HOSPITAL

- S. DALE SPOTTS and HUGH ROBERTSON—9 Operative and dry clinic
 L. K. FERROUSON and WILLIAM H. ERB—9 Operative clinic
 Staff—9 Symposium on metabolic diseases
 EDWARD S. DILLON Surgical complications of diabetes mellitus
 WILLIAM H. ERB Diabetic surgery
 ROBERT G. TORREY Medical aspects of diseases of thyroid gland
 PATRICK J. MCCARTHY Surgery of thyroid gland
 Staff—2 Symposium on cancer
 LOUIS H. CLERF Carcinoma of larynx
 JOSEPH KALDER Malignant melanomas
 LAWRENCE CURTIS Plastic procedures of treated carcinoma
 B. P. WIDMANN Irradiation of superficial intra oral carcinomas
 JOHN HOWELL Treatment of carcinoma of rectum
 CHARLES BELHNEY Carcinoma of ovary
 JOSEPH MCFARLAND To be announced
 TRUMAN SCHNABEL Bronchogenic carcinoma
 Staff—2 Symposium on general surgery
 FENWICK BECKMAN and EDWARD CROSSAN Present status of the surgical treatment of acute osteomyelitis

- D. B. PFEIFFER Indications for gastro-enterostomy in the treatment of peptic ulcer
 S. DANA WEEDEE and WILLIAM LEMMON Subtotal gastrectomy for peptic ulcer
 I. S. HNELESKI and ELEANOR VALENTINE—3 Management of blood bank at the Philadelphia General Hospital, demonstration of apparatus technique of vene section and transfusion and laboratory studies on refrigerated blood

PRESBYTERIAN HOSPITAL

- ELDRIDGE L. ELIASON, FREDERICK BOTHE and JOHN PALL NORTH—9 Operative and dry clinic
 FLORIDGE L. ELIASON Pyloric obstruction
 FREDERICK BOTHE Mesenteric adenitis
 JOHN PAUL NORTH Unusual causes of intestinal obstruction
 F. G. HANGEN and RUTH HARREL Inhalation anesthesia in abdominal surgery
 L. K. DEAN Postoperative complications of gastro intestinal operations

PROTESTANT EPISCOPAL HOSPITAL

- E. T. CROSSAN and staff—9 Operations

ST CHRISTOPHER'S HOSPITAL

- HARRY E. KNOX, JOHN WOLF, and DR. MARTIN—10 Pediatric surgery

ST JOSEPH'S HOSPITAL

- C. S. HERRMAN—9 Operations
 V. R. MANNING—2 Proctological clinic

ST LUKE'S AND CHILDREN'S HOSPITAL

- DESIDERIO ROMAN, R. W. LARER, H. K. ROESSLER, A. W. HAMMER and staff—9 Operative clinic
 JOHN O. BOWER and staff—9 Dry clinic A demonstration of the use of 50 chromic catgut in pericardectomy and common bile duct neurotomy and tenotomy
 J. W. POST—9 Demonstration Roentgenological examinations
 O. F. BARTHMAIER—9 Demonstration Pathological and bacteriological examinations

ST MARY'S HOSPITAL

- J. J. TOLAND JR.—9 Operations

TEMPLE UNIVERSITY HOSPITAL

- W. WAYNE BARCOCK, G. MASON ASTLEY and J. NORMAN COOMBS—9 Operations
 E. EDWARD CHAMBERLAIN and staff—9 Radiological clinic
 WILLIAM A. STEEL and C. HOWARD MCDONNELL—2 Dry clinic General and emergency surgery

U. S. NAVAL HOSPITAL

- F. L. CONKLEN, W. T. LIVEDERRY and H. L. PUGH—9 Operations
 J. J. WHITE—9 Demonstration Kettering Simpson by perthorm
 J. J. WHITE—1 Demonstration Kettering Simpson by perthorm

WEST JERSEY HOMEOPATHIC HOSPITAL

- H. WESLEY JACK and staff—10 Operations Repair of hernias
 H. WESLEY JACK and staff—1 Operations Carcinoma of breast, appendectomy

WOMAN'S HOSPITAL OF PHILADELPHIA

- CALVIN M. SMITH JR. and staff—9 Operations

Friday

ABINGTON MEMORIAL HOSPITAL

DAMON B. PREIFFER, J. WALTER LEVERING and J. M. DEANER—2 Operations

AMERICAN ONCOLOGIC HOSPITAL

JOHN W. BRANSFIELD and CORDON CASTICIANO—9 30
Operative and dry clinic Cancer of breast

BRYAN MAWR HOSPITAL

WALTER I. LEE and T. McKENNA DOWNS—9 Operations

COOPER HOSPITAL

WILLIAM M. MCKAY, I. E. DEIBERT, F. W. SHAFER and R. S. GANON—9 Operative clinic General abdominal and thoracic surgery

FITZGERALD MERCY HOSPITAL

BASIL R. BELTRAN—9 Operations
ALEXANDER I. BURKE—9 Operations

GRIFFIN TOWN HOSPITAL

CHARLES F. MITCHELL, WALTER F. LEE, HARRY F. HAYES and THOMAS M. DOWNS—10 Operations

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

WALTER E. LEE and HENRY E. FROE BOCKUS—9 Clinical conference Gastrointestinal diseases diagnosis treatment and surgical problems (Demonstrations of cases)
WALTER E. LEE, HARRY FARRELL, JONATHAN RHODES and NORMAN E. FREEMAN—11 Operative clinic

HAINLMANN HOSPITAL

HENRY S. RUTH—1 Demonstration of sacral caudal block
JAMES D. BROWFIELD and staff—2 Operation

HOSPITAL FOR DISEASES OF STOMACH

HERBERT P. HAWTHORNE, WILBER W. OAKS and ILLIAM H. EISEN—9 Operative and dry clinic
FRANCIS A. MANTZ—5 Operative and dry clinic

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

E. L. ELIASON and staff—9 Gastrointestinal operations
E. L. ELIASON—Management of bleeding ulcer cases
ROBERT B. BROWN—Diagnostic difficulties in colonic lesions
L. K. FERGUSON—Colonic operations Surgical diathesis in treatment of rectal disease
WILLIAM H. EISEN—Postoperative care of peptic ulcer cases
JULIAN JOHNSON—Treatment of acute ileitis
L. K. FERGUSON and staff—2 Treatment of diseases of the anal canal and rectum
I. H. HERGENROTHER—Treatment of hemorrhoids by injection hemorroidectomy in ambulatory patients with local anesthesia
JOHN B. CLUMEY—Treatment of fissure in ano in ambulatory patients by using soluble anesthetics
KENNETH KRESSLER—The treatment of pruritus ani
JOEL NASS—Treatment of carcinoma of the rectum and of rectal polyps by electro-surgery
PAUL H. SHIFFER—Nonoperative treatment of ulcerative colitis
L. K. FERGUSON—One and two stage operations for fistula in ano

JEFFERSON HOSPITAL

(FORCE) MILLER and staff—9 Dry clinic Ward walks and case demonstrations
JAMES SLIVER—Surgical demonstration Small bowel tumors
(FORCE) WILLIAMS—Treatment of varicose veins
HOWARD H. BRADSHAW—Ward rounds
ROBERT L. AYER and GUERMAN EGER—11 Varicose vein clinic
GEORGE F. MILLER and staff—11 Operations
THOMAS J. SHULLOW—11 Operations
Staff—2 Regular meeting of tumor clinic department of neoplastic diseases
J. HALL ALLEN and BENJAMIN HASKELL—10 Lesions of the anus and rectum

JEWISH HOSPITAL

NORMAN S. ROTHSCHILD—9 Operations
HENRY TUME—9 Gastroscopic clinic

LANKFORD HOSPITAL

GEORGE F. MILLER, GILSON C. FROEL, JOSEPH O. KEELER and HANS MAY—9 Operations Dry clinic Correlating surgical with medical division regarding pre and post operative care of gastric diabetic peptic ulcer and jaundiced patients
GILSON C. FROEL and HANS MAY—11 Fractures of the neck of the femur treatment and pathology with general discussion

MEMORIAL HOSPITAL

JAMES LERMAN—9 Operations

MISERICORDIA HOSPITAL

J. A. KELLY and D. C. GEIST—9 Operation
T. J. RYAN—9 Operations and symposium on peripheral vascular disease

MOUNT SINAI HOSPITAL

BENJAMIN LIPSCHITZ and LOUIS KAPLAN—9 Operations
Postoperative distention perforation in appendicitis
MOSES BEHREND and staff—15 Operations

PENNSYLVANIA HOSPITAL

JOHN B. FLOCK and staff—9 Operative and dry clinic

PHILADELPHIA GENERAL HOSPITAL

PATRICK J. MCCARTHY—9 Operative and dry clinic
B. P. WIDMANN—2 Radium and x-ray therapy

PRESBYTERIAN HOSPITAL

HENRY I. BROWN and ORVILLE C. KINC—9 Operative and dry clinic

PROTESTANT EPISCOPAL HOSPITAL

I. M. BOVING and staff—9 Operations

ST. JOSEPH'S HOSPITAL

JAMES A. KELLY—10 Operations

ST. LUKE'S AND CHILDREN'S HOSPITAL

DESIDERIO ROMAN, R. W. LARER, H. A. ROESSLER and H. HAMMER and staff—9 Operative clinic
J. W. POST—9 Roentgenological examinations
O. F. BARTHMEIER—9 Demonstration Pathological and bacteriological examinations

ST. MARK'S HOSPITAL

P. A. MCCARTHY—9 Operations
J. A. KELLY and E. H. WEISS—9 Operation

STETSON HOSPITAL

WILLIAM T. ELLIS and J. K. MARKS—12 Operations
 CARL F. KOENIG—2 X ray clinic
 ROBERT S. ALSTON and C. E. SCHWARTZ—2 Operations

TEMPLE UNIVERSITY HOSPITAL

W. WAYNE BABCOCK, G. MASON ASTLEY, W. EMORY BURNETT and J. NORMAN COOMBS—9 Operations
 W. EDWARD CHAMBERLAIN and staff—9 Radiological clinic
 WILLIAM A. STEEL and C. HOWARD McDEVITT—2 Dry clinic General and emergency surgery
 CARROLL S. WRIGHT—2 Dermatology and syphilology

HARRY Z. HIBSHMAN, HARRY E. BACON and staff—3 Operative and dry clinic

WEST JERSEY HOMEOPATHIC HOSPITAL

H. WESLEY JACK and staff—10 Operations Carcinoma of breast

H. WESLEY JACK and staff—1 Operations Appendectomy

WOMAN'S MEDICAL COLLEGE HOSPITAL

HUBLEY R. OWEN—10 Operative clinic Hernia
 JAMES LEHMAN—10 Operative clinic Thyroid
 J. STEWART RODMAN—10 30 Operative clinic Breast

OBSTETRICS AND GYNECOLOGY

Monday

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

Daily Scientific Exhibits

DOUGLAS P. MURPHY Tocographic studies of uterine motility during pregnancy and labor
 PAUL O. KLINGENSMITH Exhibits showing influence of variations in pelvic configuration upon the mechanism of labor
 CARL BACHMAN Exhibits showing the techniques for the quantitative determination of estrogens and pregnandiol in pregnancy urine
 FRANKLIN L. PAYNE Hormone studies in hydatidiform mole and chorion epithelioma
 F. SIDNEY DUNNE Functioning ovarian tumors

MEMORIAL HOSPITAL

Z. B. NEWTON—4 Gynecological operations

TEMPLE UNIVERSITY HOSPITAL

HARRY A. DUNCAN—12 Operative and dry clinic
 Obstetrical staff Daily exhibition and demonstration on fluid balance and weight control in pregnancy

WOMAN'S HOSPITAL OF PHILADELPHIA

ELEANOR H. BALPH and staff—1 Urological and gynecological clinic

Tuesday

BROAD STREET HOSPITAL

N. F. PAXSON and M. J. BENNETT—9 Operative and dry clinics Ovarian grafting as a therapeutic method for endocrine disorders presentation of cases of hypermenorrhea and hypomenorrhea pre and postoperative technique of new method discussion and illustration by motion pictures in color

N. F. PAXSON and M. J. BENNETT—2 Operations Ovarian grafting for hyper and hypomenorrhea 4 cases

BRYN MAWR HOSPITAL

CHARLES A. BEHNEY—9 Gynecological operations

COOPER HOSPITAL

T. B. LEE and GORDON F. WEST—9 Operations

DELAWARE COUNTY HOSPITAL

CLIFFORD B. LULL and J. VERNON ELLSON—9 Operations

FITZGERALD MERCY HOSPITAL

JOSEPH V. MISSETT—11 Gynecological operations

HAHNEMANN HOSPITAL

NEWLIN F. PAXSON and HENRY D. LAFFERTY—9 Clinical pathological conference and ward rounds Chronic nephritis and pregnancy placenta praevia x ray pelvimetry

HOSPITAL FOR DISEASES OF STOMACH

MARIO A. CASTALLO—11 Operative and dry clinic

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

CHARLES C. NORRIS, HOWARD C. TAYLOR JR. and staff—9 Gynecological operations and demonstrations
 CHARLES C. NORRIS, CHARLES A. BEHNEY, and PENDLETON TOMPKINS—2 Round table discussion The treatment of cervical carcinoma George Gray Ward New York, chairman

JEANES HOSPITAL

ROSCOE M. TEAHAN, HOPE WARMOCK and CLARENCE A. WHITCOMB—9 Operations Panhysterectomy for carcinoma of uterine fundus application of radium for carcinoma of cervix vulvectomy for carcinoma radical neck dissection for metastatic carcinoma

JEFFERSON HOSPITAL

P. BROOKE BLAND—9 Gynecological operations
 HARRY STUCKERT—10 Obstetrical ward rounds
 JOHN B. MONTGOMERY—12 Postoperative follow up clinic
 J. B. BERNSTINE and GEORGE B. BLAND—12 Demonstration of vaccine prevention of puerperal sepsis
 MARIO CASTALLO—12 30 Organization and conduct of obstetrical clinic for treatment of syphilis and gonorrhea complicating pregnancy results of ten years experience

KENSINGTON HOSPITAL FOR WOMEN

F. A. SCHUMANN, ADRIAN VORGELEN, Z. B. NEWTON, F. J. KOWNACKI, C. T. BEECHAM, and GEORGE C. HANNA JR.—9 Gynecological operations with special reference to anesthesia Hysterectomy avertin plastic morphine and scopolamin laparotomy ovarian cyst local cesarean section local

LANKENAU HOSPITAL

E. P. BARNARD—10 Dry clinic followed by cesarean section
 J. CALVIN HARTMAN Use of Keiland forceps
 ROSS B. WILSON Obstetric analgesia
 JULIAN LYON Care of the premature baby

MISERICORDIA HOSPITAL

J. A. SHARKEY—3 Lecture Postpartum pulmonary complications

PENNSYLVANIA HOSPITAL

- NORRIS W. VAUX and staff—9 Operations and demonstration of cases
- NORRIS W. VAUX and staff—2 Demonstration of Lying In Hospital technique and procedure
- SPOTSWOOD ROBINS Admission of patient and assignment to accommodation
- J. VERNON ELLSON Prenatal care
- CRAIG WRIGHT MCKEY Special clinics
- ROBERT M. SHUREY Preparation of patient for labor
- ROSS B. WILSON—Observation of patient in labor
- CLIFFORD B. LULL Delivery room setup obstetrical technique and procedures
- JOHN C. ULLERY Care of the patient immediately postpartum
- ROBERT A. KIMBROUGH Care of the patient throughout puerperium while in the hospital
- F. SIDNEY DUNNE Follow up and end results
- LENDLETON S. TOMPKINS Out patient clinic
- RALPH M. TYSON Care of the newborn

PHILADELPHIA GENERAL HOSPITAL

- C. A. BEHNKY—11 Dry clinic Tumors in gynecological practice

PRESBYTERIAN HOSPITAL

- GEORGE M. LAWS, JAMES P. LEWIS and DONALD RIEGEL—2 Gynecological operations

PRESTON RITRI AT

- JOHN C. HIRST, ROBERT SHUREY and ROBERT SHOEMAKER—2 Demonstration of methods results and clinical significance of studies in Vitamin A in pregnancy as indicated by visual purple estimation from the Feldman adaptometer surgical demonstration of technique of puerperal sterilization from first to fifth postpartum day by means of Pomeroy tubal ligation sterilization through the Pfannenstiel incision under local anesthesia motion picture in color of the new Pfannenstiel B. C. Hirst Kerr extraperitoneal cesarean section followed by operation if case is available

ST. LUKE'S AND CHILDREN'S HOSPITAL

- WARREN C. MERCER and staff—9 Operative clinic Supravaginal hysterectomies and vaginal repairs

ST. VINCENT'S HOSPITAL

- WILLIAM F. MORRISON—10 Female gonorrheal clinic Administering cautery and exhibition of cauterized cases

STETSON HOSPITAL

- STEPHEN E. TRACY and staff—9 Gynecological clinic

TEMPLE UNIVERSITY HOSPITAL

- J. O. ARNOLD—3 Obstetrical clinic round table discussion

WOMAN'S HOSPITAL OF PHILADELPHIA

- MARGARET C. BURGIS and staff—9 Operative and dry clinics Gynecological sterility
- ALBERTA PELTZ and staff—9 Prenatal clinic

WOMEN'S HOMEOPATHIC HOSPITAL

- F. L. HUGHES—9 Gynecological clinic

Wednesday

AMERICAN ONCOLOGIC HOSPITAL

- STEPHEN E. TRACY, A. VAUGHAN WINCHELL and F. HENRY F. CICCONI—10 Operative and dry clinic Cancer of cervix

BRYAN MAWR HOSPITAL

- JAMES L. RICHARDS—9 Gynecological operations Suspension of uterus and hysterectomy

CHISTNUT HILL HOSPITAL

- FRANKLIN L. PAYNE—9 Operations
- EDWARD A. SCHULMAN and CLAYTON T. BEECHAM—9 30 Operations

FITZGERALD MERCY HOSPITAL

- W. BENSON HARER—9 Gynecological operations

IRANFORD HOSPITAL

- GEORGE C. HANNA, JR. and WALLACE M. MARTIN—1 30 Operative and dry clinics Obstetrical

JERMANTOWN HOSPITAL

- I. I. BARNARD and J. CALVIN HARTMAN—9 Operative and dry clinics
- J. CALVIN HARTMAN Discussion on prenatal care
- Z. B. NEWTON Operations
- WINSLOW TOMPKINS Relationship between diet and the anemias of pregnancy
- CHRISTOPHER M. TURMAN Interpartum separation of the pubic symphysis
- ROBERT L. ITTIFIELD Use of typhoid vaccine in phlebitis
- JOHN W. COULTER Signs and symptoms of premature separation not always a text book type

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

- W. R. NICHOLSON—9 Gynecological operations

HAYENEMANN HOSPITAL

- LEON CLEMMER and NEWLIN F. PAXSON—2 Obstetrical operations

HOSPITAL FOR DISEASES OF STOMACH

- FRANCIS H. CATON—2 Urethral lesions in women

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

- CARL E. BACHMAN and staff—9 Obstetrical operations and demonstrations
- DOUGLAS P. MURPHY and PAUL O. KLINGEN SMITH—2 Round table discussion The relative importance of disproportion and inertia uteri in full term labor WILLIAM I. CALDWELL New York chairman

J. FITZGERALD HOSPITAL

- BROOKE M. ANSPACH JOHN B. MONTGOMERY and staff—9 Operations
- THADDEUS L. MONTGOMERY MARIO CASTALDO and CLAY SPANGLER—9 Operations
- ARTHUR FIRST—12 Endocrine factors in the vitality and development of the fetus
- ABRAHAM RAKOFF—12 New methods in the titration of prolactin and estrin results of such titration in normal and complicated pregnancies
- L. G. FEO—12 Studies in the parasitology and bacteriology of the vagina
- LEOPOLD GOLDSTEIN—12 Glycogen content and acidity of the vagina in pregnancies and its complications

MEMORIAL HOSPITAL

- A. W. VOEGELIN—2 Gynecological operations

METHODIST EPISCOPAL HOSPITAL

- L. C. HAMBLock and staff—9 Obstetrical operations and demonstration of Caldwell-Morton apparatus for pelvicography

MOUNT SINAI HOSPITAL

CHARLES MAZER and staff—9 Operations Exhibition and motion pictures Investigative problems of the barren marriage

PENNSYLVANIA HOSPITAL

NORRIS W VAUX and staff—9 Operations and demonstration of cases

PHILADELPHIA COUNTY MEDICAL SOCIETY

Demonstration of Committee Activities—4 30 Each committee will take a half hour and discuss three typical deaths in their respective group Round table discussion

PHILIP F WILLIAMS chairman Committee on Maternal Welfare

THADDEUS L MONTGOMERY chairman Committee on the Study of Fetal Deaths

RALPH TYSON chairman Committee on the Study of Neo Natal Deaths

PRESBYTERIAN HOSPITAL

CHARLES BEHNEY and JOHN GRIFFITH—9 Gynecological clinic

ST JOSEPH'S HOSPITAL

F H MAIER—11 Gynecological operations

HARRY STUCKERT—11 Obstetrical clinic

J F CARROLL—2 Obstetrical clinic

ST MARY'S HOSPITAL

L J WOJCZYNSKI—9 Gynecological clinic

P J CARRERAS—9 Obstetrical clinic

J M LAFERTY—1 Obstetrical clinic

W H SCHMIDT—1 Radiological clinic

TEMPLE UNIVERSITY HOSPITAL

J O ARNOLD—3 Obstetrical clinic round table discussion

WOMAN'S HOSPITAL OF PHILADELPHIA

ALBERTA FELTZ and staff—9 Prenatal clinic

*Thursday***BROAD STREET HOSPITAL**

N F PAXSON and M J BENNETT—9 Demonstration New method of studying ovarian activity and the menstrual cycle by means of human vaginal smears Lantern slide demonstration and visit to laboratory showing technique Normal cycle artificial castration menopause hypermenorrhea hypomenorrhea

N F PAXSON and M J BENNETT—2 Clinical conference Ovarian graft as a therapeutic method for endocrine disorders presenting cases of castration and menopause postoperative follow up discussion of technique used illustrated by motion pictures in color

BRYN MAWR HOSPITAL

J O GRIFFITHS and J L HOWSON—2 Obstetrical clinic

COOPER HOSPITAL

T B LEE and GORDON F WEST—9 Operative clinic Gynecological

A B DAVIS and G B GERMAN—2 Operative and dry clinic Maternal mortality in New Jersey

FITZGERALD MERCY HOSPITAL

JOSEPH V MISSETT—11 Gynecological operations

HAHNEMANN HOSPITAL

EARL B CRAIG and FRANK J FROSCH—9 Operative and dry clinic Gynecological

EARL B CRAIG and FRANK J FROSCH—2 Operative and dry clinic Gynecological

HOSPITAL FOR DISEASES OF STOMACH

TOBY A GRECO—9 Interposition and Fothergill operations

J S RAUDENBUSH—11 Operative and dry clinic

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

CHARLES C NORRIS HOWARD C TAYLOR JR and staff—9 Gynecological operations and demonstrations

FRANKLIN L PAYNE—2 Round table discussion The diagnosis and treatment of hydatidiform mole and chorionepithelioma BENJAMIN P WATSON New York chairman

JEFFERSON HOSPITAL

LEWIS C SCHEFFY I CHARLES LINTGEN and staff—9 Operations

CLYDE M SPANGLER—10 Ward rounds

M M GINSBERG—10 30 Cystoscopic clinic

EDWARD BURT—11 Studies in fetal asphyxia

THADDEUS L MONTGOMERY—11 Intrapartum factors in fetal and maternal mortality

JOHN H DUGGER—11 A study of rupture of the uterus

Staff—12 Round table discussion The practical application of endocrine therapy in gynecological and obstetrical practice Discussion to be participated in by a number of the leading gynecologists and obstetricians

EMIL NOVAK Baltimore chairman

I CHARLES LINTGEN—12 Postoperative follow up clinic

BROOKE M ANSFACH and JEWIS C SCHEFFY—3 Clinical conference on gynecology

MOUNT SINAI HOSPITAL

BERNARD MANN and staff—9 Operations

NORTHEASTERN HOSPITAL

ALFRED H DIEBEL—10 Gynecological operations

PENNSYLVANIA HOSPITAL

NORRIS W VAUX and staff—9 Operations and demonstration of cases

NORRIS W VAUX and staff—2 Demonstration of Lying in Hospital technique and procedure

SPORSWOOD ROBINS Admission of patient and assignment to accommodation

J VERNON ELLSON Prenatal care

CRAIG WRIGHT MUCKLE Special clinics

ROBERT M SHIREY Preparation of patient for labor

ROSS B WILSON Observation of patient in labor

CLIFFORD B LULL Delivery room setup obstetrical technique and procedure

JOHN C ULLERY Care of the patient immediately post partum

ROBERT A KIMBROUGH Care of the patient throughout puerperium while in the hospital

F SIDNEY DUNNE Follow up and end results

PENDETOWN TOMPKINS Out patient clinic

RALPH M TYSON Care of the newborn

PHILADELPHIA GENERAL HOSPITAL

EDWARD A SCHUMANN JOSEPH MISSETT JR, WILLIAM ELY and C BECHAM—9 Gynecological operations

PRESBYTERIAN HOSPITAL

GEORGE M LAWS and staff—2 Gynecological operations

PHILIP F WILLIAMS—2 Demonstration of prenatal clinic

ST JOSEPH'S HOSPITAL

WILLIAM J THUDICUM—11 Operations Hysterectomy for fibromyoma Fothergill operation for proclitania

ST LUKE'S AND CHILDREN'S HOSPITAL

LEO IARD AVERETT and staff—10 Operative clinic Vaginal approach to pelvic pathology and vaginal hysterectomies Kerr low cervical cesarean section

ST MARY'S HOSPITAL

J G SABOL—9 Gynecological clinic

STETSON HOSPITAL

STEPHEN E TRACY and staff—9 Gynecological clinic

WEST JERSEY HOMEOPATHIC HOSPITAL

C F HADLEY E C HESSERT and staff—10 30 Gynecological operations

ROMAN'S MEDICAL COLLEGE HOSPITAL

FAITH S FETTERMAN—9 Demonstration of patients and technique Fulguration treatment of ulcerative submucous cystitis

MARGARET C STURGIS—10 Demonstration Uterosal pinography technique and evaluation of uterosal pinograms

CATHARINE MACFARLANE and HELEN INGLEBY—11 Round table conference Value of periodic pelvic examinations in preventing cancer of the uterus report on the findings in 1200 volunteers

CATHARINE MACFARLANE and staff—2 Gynecological operations

WOMEN'S HOMEOPATHIC HOSPITAL

W C MERCER—9 Gynecological clinic

Friday

BROAD STREET HOSPITAL

W C MERCER—9 Operations Uterine fibroid hysterectomy anterior and posterior colpoperhaphy uterine suspension

BRYN MAWR HOSPITAL

JOHN B MONTGOMERY and THOMAS J COSTELLO—2 Résumé of obstetrical clinic

CHESTNUT HILL HOSPITAL

7 B NEWTON and H CURTIS WOOD—11 Operations

FITZGERALD MERCY HOSPITAL

W BENSON HARER—9 Gynecological operations

HAHNEMANN HOSPITAL

HENRY L CROWTHER and RICHARD R CATES—10 Care of premature baby management of abortion

HOSPITAL FOR DISEASES OF STOMACH

HARRY STUCKERT—11 Gynecological operations

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

CARL BACHMAN and staff—9 Obstetrical operations and demonstrations

PHILIP I WILLIAMS—12 Round table discussion Treatment of abortion FREDERIC J TAUSIG St. Louis Missouri chairman

JEFFERSON HOSPITAL

P BROOKE BLAND—9 Operations

JAMES L RICHARDS THOMAS J COSTELLO and DAVID M FARRELL—9 Operations

CLYDE SPANGLER—10 Ward rounds

IRVING C SCHIFF and WILLIAM J THUDICUM—11 30 Uterine cancer follow up clinic

JACOB HOFFMAN—12 Endocrinological clinic

NORRIS W VAUX and HUBERT A REIMANN—12 Symposium Pulmonary complications in obstetrical and surgical practice

PENNSYLVANIA HOSPITAL FOR WOMEN

WALTER W HEYL—9 Demonstration of the use of a placental blood bank

MR STEINBERG and MR BROWN—9 Demonstration of the principles of blood coagulation and the control of hemorrhages

E A SCHUMANN and staff—9 Obstetrical operations

MOUNT SINAI HOSPITAL

CHARLES MAZER and staff—9 Operations

PENNSYLVANIA HOSPITAL

NORRIS W VAUX and staff—9 Operations and demonstration of cases

PHILADELPHIA CENTRAL HOSPITAL

CHARLES S MILLER and FRANKLIN F OSTERHOUT—11 Operative and dry clinic

ST JOSEPH'S HOSPITAL

D S O DONOVAN—12 Obstetrical clinic

P W GILHOOL—2 Obstetrical clinic

TEMPLE UNIVERSITY HOSPITAL

HARRY A DUNCAN—12 Operative and dry clinic Gynecological

J O ARNOLD—3 Dry clinic and round table discussion Obstetrics

ROMAN'S MEDICAL COLLEGE HOSPITAL

ANN GRAY TAYLOR—2 Obstetrical clinic Abnormal cases

Days to be Announced

JEWISH HOSPITAL

C J STAMM JACOB WALKER and PHILIP F WILLIAMS Operations

GENITO URINARY SURGERY

Monday

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

JOSEPH C BIRDSALL and staff—2 Operative and dry clinic

PENNSYLVANIA HOSPITAL

WILLIAM J ERICSSON—2 Renal calculus research clinic

ST MARY'S HOSPITAL

W H HAINES—1 Operative and dry clinic

TEMPLE UNIVERSITY HOSPITAL

W HERSEN THOMAS and staff—3 Operative and dry clinic

Tuesday

GERMANTOWN HOSPITAL

STANLEY Q WEST and HAROLD S RAMBO—10 Operative and dry clinic

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

WILLIAM H MACKINNEY and EDWARD A MULLEN—2 Operative and dry clinic

HAINEMANN HOSPITAL

LEON T ASHCRAFT and WILLIAM HUNSICKER JR—2 Operations

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

ALFRED RANDALL and staff—2 Operative and dry clinic

JEFFERSON HOSPITAL

D M DAVIS—9 Diagnostic clinic ward walk

JEWISH HOSPITAL

JOHN B LOWNES—9 Operations
LEON SOLIS COHEN—9 Urological radiological exhibit

MOUNT SINAI HOSPITAL

MAURICE MUSCHAT and staff—130 Operations

ST LUKE'S AND CHILDREN'S HOSPITAL

L F MILLIKEN and staff—2 Dry clinic Plastic surgery of the kidney demonstration of cases

TEMPLE UNIVERSITY HOSPITAL

W HERSEY THOMAS and staff—3 Operative and dry clinic

U S NAVAL HOSPITAL

V H CARSON and G E GAYLER—9 Operations
V H CARSON and G E GAYLER—2 Dry clinic

Wednesday

ABINGTON MEMORIAL HOSPITAL

ALEXANDER RANDALL and staff—9 Operations

CHESTNUT HILL HOSPITAL

ALEXANDER RANDALL, FREDERICK S SCHOFIELD and FRANK P MASSANISO—11 Operations

COOPER HOSPITAL

D F BENTLEY and R BETANCOURT—2 Operative and dry clinic Prostatic surgery

GERMANTOWN HOSPITAL

JOHN B LOWNES, F S SCHOFIELD and FRANK P MASSANISO—10 Operative and dry clinic

HAINEMANN HOSPITAL

LEON T ASHCRAFT and WILLIAM HUNSICKER JR—9 Operations

JEFFERSON HOSPITAL

D M DAVIS and staff—9 Operations
KARL KORNBLUM—9 Urological radiological cases

PHILADELPHIA GENERAL HOSPITAL

WILLIAM H MACKINNEY, W HERSEY THOMAS WILLARD H KINNEY and EDWARD A MULLEN—9 Symposium on genito urinary diseases

PRESBYTERIAN HOSPITAL

JOSEPH C BIRDSALL, FRANCIS G HARRISON and HENRY SANGREE—2 Operative and dry clinic

ST JOSEPH'S HOSPITAL

WILLIAM J EZICKSON—2 Round table discussion on urological problems

ST LUKE'S AND CHILDREN'S HOSPITAL

E W CAMPBELL and staff—9 Operative and dry clinics

ST MARY'S HOSPITAL

W H HAINES—2 Operations

Thursday

AMERICAN ONCOLOGIC HOSPITAL

A F BOTHE and EMMETT F CICCONE—10 Operative and dry clinic Cancer of genito urinary tract

CHESTNUT HILL HOSPITAL

FREDERICK S SCHOFIELD—9 Operations

DELAWARE COUNTY HOSPITAL

W H KINNEY—10 Operative and dry clinic

GERMANTOWN HOSPITAL

STANLEY Q WEST and HAROLD S RAMBO—10 Operative and dry clinic

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

ALEXANDER RANDALL and staff—2 Dry clinic
P B HUGHES Bilateral functional effect of unilateral renal denervation in nephrosis

S W MUTHOLLAND Relationship of urology to the problem of hypertension

ALEXANDER RANDALL The etiology of renal calculus
E P PENDRGRASS and P B HUGHES The value of serial pyelography in evaluating the efficiency of urinary transportation

Staff members Informative case reports

JEFFERSON HOSPITAL

D M DAVIS and staff—9 Operations

MEMORIAL HOSPITAL

E A MULLEN—3 Operations

MISERICORDIA HOSPITAL

A E BOTHE—2 Operations

MOUNT SINAI HOSPITAL

MAURICE MUSCHAT and staff—130 Operations

PENNSYLVANIA HOSPITAL

LEON HERMAN and staff—2 Operative and dry clinic

TEMPLE UNIVERSITY HOSPITAL

W HERSEY THOMAS and staff—3 Operative and dry clinic

U S NAVAL HOSPITAL

V H CARSON—2 Dry clinic

WOMAN'S MEDICAL COLLEGE HOSPITAL

FAITH S FETTERMAN—9 Operative and dry clinic

WOMEN'S HOMEOPATHIC HOSPITAL

LEON T ASHCRAFT—230 Operative and dry clinic

Friday

ABINGTON MEMORIAL HOSPITAL

ALEXANDER RANDALL and staff—9 Operations

BRYN MAWR HOSPITAL

LEON HERMAN and LLOYD B. GREEN—2 Operations

GERMANTOWN HOSPITAL

JOHN B. LOWNES, T. S. SCHOFIELD and FRANK P. MANSANO—10 Operative and dry clinic

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

JOSEPH C. BIRDSALL—2 Operative and dry clinic

HAINEMANN HOSPITAL

LEON T. ASHCRAFT and WILLIAM HUNSECKER, JR.—9 Operations

FRACTURES AND OTHER TRAUMAS

Monday

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

L. K. FERGLSON, WILLIAM H. FREDERICK, W. D. THOMPSON and LOUIS KAPLAN—2 Traumatic surgery. Immediate treatment of traumatic wounds. treatment of sprains by injection of local anesthesia. diagnosis and treatment of knee injuries. prophylaxis and treatment of tetanus. prophylaxis and treatment of gas gangrene

PROTESTANT EPISCOPAL HOSPITAL

I. M. BOYKIN—2 Fractures of lower third of leg. industrial clinic

Tuesday

ABINGTON MEMORIAL HOSPITAL

DAMON B. PFEIFFER, J. WALTER LEVERING, J. MONTGOMERY DEAYER and FLETCHER SATIN—3 Fracture clinic. Demonstration of cases or treatment of compound fractures. fracture dislocation of shoulder. closed skeletal reduction cases. open reduction cases. clinic in operation

JEWISH HOSPITAL

MOSES BEHREND—9 Dry clinic. Compound fractures. immediate fixation and metal plates

RALPH COLDSMITH and staff—9 Fracture clinic

MISERICORDIA HOSPITAL

F. MOGAVERO—11 Lecture. Experiences with the Smith Petersen nail

PRESBYTERIAN HOSPITAL

JOHN PAUL NORTH—9 Dry clinic

ORVILLE C. KING. Walking casts

AUGUSTUS THORNDIKE (Boston). Sprains of the ankle joint

THEODORE I. ORR. Traumatic dislocations of the hip. JAMES B. MASON. Use of cellulose acetate compound for casts and dressings

TOM OUTLAND (Sayre). Tears of the supraspinatus tendon

JOHN PAUL NORTH. Hanging casts in fractures of the humeral shaft

JEFFERSON HOSPITAL

D. M. DAVIS and staff—9 Operations

JEWISH HOSPITAL

JOHN B. LOWNES—9 Operations

LEON SOLIS COHEN—9 Urological radiological exhibit

METHODIST EPISCOPAL HOSPITAL

STERLING W. MOORHEAD and staff—10 Operations

MISERICORDIA HOSPITAL

A. E. BOTHE—2 Dry clinic. Kidney tumors. types and treatment

TEMPLE UNIVERSITY HOSPITAL

W. HERSEY THOMAS and staff—3 Operative and dry clinic

WOMAN'S HOSPITAL OF PHILADELPHIA

LATHA S. FETTERMAN and staff—9 Urological dry clinic

ST JOSEPH'S HOSPITAL

J. A. LEHMAN—11 Industrial surgery clinic. Living fascial suture in repair of hernia

TEMPLE UNIVERSITY HOSPITAL

JOHN ROYAL MOORE—9 Fracture clinic

WEST JERSEY HOMEOPATHIC HOSPITAL

H. WESLEY JACK and staff—1 Operative and dry clinics. Discussion and presentation of 4 cases of removal of spleen following trauma

Wednesday

COOPER HOSPITAL

Staff—9 Operative and dry clinic

NORTHEASTERN HOSPITAL

T. TURNER THOMAS—11 Demonstration of patients. x rays and end results. Femur (1) shaft (2) intracapsular fractures with and without screw fixation. fractures of tibia and fibula. Pott's fractures with and without posterior dislocation of the ankle. marginal fracture of the tibia. fractures of calcis. fractures and dislocation at the shoulder, elbow and wrist. motion pictures

PHILADELPHIA GENERAL HOSPITAL

Staff—2 Symposium on fractures

CLAY McRRAY, S. HILDOCK and HARRISON McLAUGHLIN. Fractures of the shoulder girdle

R. F. BLIZRY. Fractures about the elbow

TOM OUTLAND. Fractures of the forearm

Thursday

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

ROBERT A. GROFF—9 Clinical conference. Responsibility of industry in the management of head injuries. BERNARD D. JUDOVITCH—10 Dry clinic. Back injuries in industrial surgery

JOHN C. HOWELL—11 Demonstration. Restoration of joint function after fractures. pain in groin following lifting. tendon repair in industrial surgery

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA
 L K FERGUSON LOUIS KAPLAN and L H HERCSEHIMER
 —2 Treatment of fractures in ambulatory patients clinical demonstration technique and application of unpadded plaster casts for the upper and lower extremities reduction of fractures under local anesthesia practical physiotherapy in fractures by active function treatment of minor ankle fractures by injection of local anesthesia

JEWISH HOSPITAL

RALPH GOLDSMITH and staff—9 Fracture clinic

SURGERY OF BONES AND JOINTS

Monday

CHILDREN'S HOSPITAL

J T NICHOLSON—2 Demonstration of splints Polomyelitis Prevention of foot deformities in younger children by equalization of tendon pull muscle and fascial transplants

MOUNT SINAI HOSPITAL

M B COOPERMAN—2 Operations

PROTESTANT EPISCOPAL HOSPITAL

RUTHERFORD L JOHN—1 30 Orthopedic clinic

Tuesday

COOPER HOSPITAL

B FRANKLIN BUZBY OSWALD R CARLANDER and DR WALLIS—9 Operative and dry clinics Elbow injuries spinal fusion

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

DEFOREST P WILLARD JESSE T NICHOLSON, and BEN JAMIN T BELL—9 Operative and dry clinics (1) Reconstruction operation in older congenital hip cases (2) unusual spine lesions responsible for backache (3) correction of metatarsus varus in hallux valgus

ST JOSEPH'S HOSPITAL

PAUL JEPSON—1 Dry clinic Low back strain fusion for chronic low back strain

ST LUKES AND CHILDREN'S HOSPITAL

JOHN A BROOKE—2 Dry clinic Tendon transplantation in selected polio cases arthrodesis of the knee serratus magnus paralysis with fascial anchorage to the spinous process

SHRINER'S HOSPITAL

J R MOORE—2 Ward walk

WOMEN'S HOMOPATHIC HOSPITAL

E O GECKELER—1 Orthopedic dry clinic Fracture cases including follow up treatment

Wednesday

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

W G ELMER L D FRESCOLN and PAUL JEPSON—12 Operations Arthroplasty elbows and hips internal derangement of knees

MEMORIAL HOSPITAL

BRUCE L ILEMITZ—9 Fracture clinic

PENNSYLVANIA HOSPITAL

FREDERICK R ROBBINS—9 Industrial clinic

Friday

COOPER HOSPITAL

R S GAMON and E R RISTINE—9 Dry clinic Fractures

ST MARY'S HOSPITAL

W J RYAN—9 Operative and dry clinic Industrial surgery

JEFFERSON HOSPITAL

J T RUCH—9 Operations

MOUNT SINAI HOSPITAL

M B COOPERMAN and staff—2 Operations

PROTESTANT EPISCOPAL HOSPITAL

J W KLOFF—10 30 Dry clinic Fractures of neck of femur use of nailing in treatment

RUTHERFORD L JOHN—1 30 Operative and dry clinic

ST CHRISTOPHER'S HOSPITAL

RUTHERFORD L JOHN—10 30 Operations

ST LUKES AND CHILDREN'S HOSPITAL

PAUL JEPSON—10 Operative clinic Internal derangement of knee exploration polydactylia, plastic surgical result nailing of fractured hip

SHRINER'S HOSPITAL

J R MOORE—9 Operations

U S NAVAL HOSPITAL

C F MORRISON—9 Operations

WEST JERSEY HOMOPATHIC HOSPITAL

S L BROWN and staff—9 Operations

Thursday

BRYN MAWR HOSPITAL

GEORGE WAGONER—9 Operations Demonstration of selected cases of healed fractures

GERMANTOWN HOSPITAL

B FRANKLIN BUZBY and A D WALLIS—9 Operative and dry clinic

HAHNEMANN HOSPITAL

JOHN A BROOKE E O GECKELER, and DONALD T JONES—2 Dry clinic Fractures of neck of femur internal fixation Smith Petersen pin or parallel screws results of leg shortening herniation of intervertebral disc shoulder disabilities orthopedic problem cases for discussion

PHILADELPHIA ORTHOPAEDIC HOSPITAL

DEFOREST P WILLARD and staff—9 Case demonstrations Treatment of Legg Calvé Perthes disease, five year results of slipped femoral epiphysis decompression of abscess for paraplegia in Pott's disease

ST JOSEPH'S HOSPITAL

PAUL JEPSON—1 Operation Fusion for chronic low back strain

Friday

ABINGTON MEMORIAL HOSPITAL

ALEXANDER RANDALL and staff—9 Operations

BRYN MAWR HOSPITAL

LEON HERMAN and LLOYD B. CREENE—2 Operations

CERMANTOWN HOSPITAL

JOHN B. LOWES, F. S. SCHOFIELD and FRANK P. MAS-
SANISO—10 Operative and dry clinic

GRADUATE HOSPITAL OF UNIVERSITY
OF PENNSYLVANIA

JOSEPH C. BIRDSALL—2 Operative and dry clinic

HAHNFMAN HOSPITAL

LLOYD T. ASHCRAFT and WILLIAM HUNSICKER, JR.—9
Operations

J. I. FILERSON HOSPITAL

D. M. DAVIS and staff—9 Operations

JEWISH HOSPITAL

JOHN B. LOWES—9 Operations
LEON SOLIS CORI—9 Urological radiological exhibit

METHODIST EPISCOPAL HOSPITAL

STIRLING W. MOORHEAD and staff—10 Operations

MISERICORDIA HOSPITAL

A. I. BOTHE—2 Dry clinic Kidney tumors types and
treatment

TEMPLE UNIVERSITY HOSPITAL

W. HERSEY THOMAS and staff—3 Operative and dry
clinic

WOMAN'S HOSPITAL OF PHILADELPHIA

LAITH S. FETTERMAN and staff—9 Urological dry clinic

FRACTURES AND OTHER TRAUMAS

Monday

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

I. K. FERGUSON, WILLIAM H. FREDERICK, W. D. THOMPSON and
L. H. KAPLAN—2 Traumatic surgery Immediate
treatment of traumatic wounds treatment of sprains by
injection of local anesthesia diagnosis and treatment of
knee injuries prophylaxis and treatment of tetanus
prophylaxis and treatment of gas gangrene

PROTESTANT EPISCOPAL HOSPITAL

I. M. BOYAN—2 Fractures of lower third of leg industrial
clinic

Tuesday

ABINGTON MEMORIAL HOSPITAL

DAMON B. PREIFFER, J. WALTER LEVERING, J. MONT-
GOMERY DEEVER and FLETCHER SAUN—3 Fracture
clinic Demonstration of cases or treatment of com-
pound fractures fracture dislocation of shoulder closed
skeletal reduction cases open reduction cases clinic in
operation

JEWISH HOSPITAL

MOSES BEHRMAN—9 Dry clinic Compound fractures
immediate fixation and metal plates
RALPH GOLDSMITH and staff—9 Fracture clinic

MISERICORDIA HOSPITAL

F. MCGAVERO—11 Lecture Experiences with the Smith
Petersen nail

PRESBYTERIAN HOSPITAL

JOHN PAUL NORTH—9 Dry clinic
ORVILLE C. KING Walking casts
ALGUSTUS THORNDIKE (Boston) Sprains of the ankle
joint
THEODORE E. ORR Traumatic dislocations of the hip
JAMES B. MASON Use of cellulose acetate compounds
for casts and dressings
TOM OUTLAND (Sayre) Tears of the supraspinatus
tendon
JOHN PAUL NORTH Hanging casts in fractures of the
humeral shaft

ST. JOSEPH'S HOSPITAL

J. A. LEHMAN—11 Industrial surgery clinic Living
fascial suture in repair of hernia

TEMPLE UNIVERSITY HOSPITAL

JOHN ROYAL MOORE—9 Fracture clinic

WEST JERSEY HOMOPOATHIC HOSPITAL

H. WESLEY JACK and staff—1 Operative and dry clinic
Discussion and presentation of 4 cases of removal of
spleen following trauma

Wednesday

COOPER HOSPITAL

Staff—9 Operative and dry clinic

NORTHEASTERN HOSPITAL

T. TURNER THOMAS—11 Demonstration of patients
x-rays and end results Femur (1) shaft (2) intracaps-
ular fractures with and without screw fixation fractures
of tibia and fibula Pott's fractures with and without
posterior dislocation of the ankle marginal fracture of
the tibia fractures of os calcis fractures and dislocations
at the shoulder elbow and wrist motion pictures

PHILADELPHIA GENERAL HOSPITAL

Staff—2 Symposium on Fractures
CLAY MURRAY, S. H. DOCK and HARRISON McLAUGHLIN
Fractures of the shoulder girdle
B. F. BUZBY Fractures about the elbow
TOM OUTLAND Fractures of the forearm

Thursday

GRADUATE HOSPITAL OF UNIVERSITY
OF PENNSYLVANIA

ROBERT A. CROFF—9 Clinical conference Respon-
sibility of industry in the management of head injuries
BERNARD D. JUDOVITCH—10 Dry clinic Back injuries in
industrial surgery
JOHN C. HOWELL—11 Demonstration Restoration of
joint function after fractures pain in groin following
lifting tendon repair in industrial surgery

HAHNEMANN HOSPITAL

THOMAS L DOYLE—9 Operations

LANKENAU HOSPITAL

HANS MAY—9 Plastic and reconstructive surgery

MOUNT SINAI HOSPITAL

V FRANK—2 Operations

ST JOSEPH'S HOSPITAL

WILLIAM J MCKINLEY—9 Operative and dry clinic

THORACIC SURGERY

Tuesday

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

JULIAN JOHNSON and staff—2 Dry clinic

RICHARD H MEADE The surgical treatment of pulmonary tuberculosis

GABRIEL TUCKER The bronchoscopic aspects of thoracic surgery

JULIAN JOHNSON The surgical treatment of pulmonary malignancy and bronchiectasis

JEFFERSON HOSPITAL

HOWARD H BRADSHAW and GEORGE WILLAUER—11 30 Dry clinic Thoracic diseases

PHILADELPHIA GENERAL HOSPITAL

Staff—9 Symposium on empyema atelectasis sulfapyridine

E L ELIASON Empyema results

E BURVILLE HOLMES Roentgenological aspects of empyema

LEON SCHWARTZ Clinical studies on sulfapyridine

V W MURRAY WRIGHT Basal atelectasis following general surgical operations

MOSES BEHREND RICHARD H MEADE JR RUBIN M LEWIS and ALBERT BEHREND—2 Operative and dry clinics Phrenic nerve operations pneumolysis thoracoplasty extrapleural pneumothorax

Wednesday

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

WALTER E LEE—10 Constrictive pericarditis

JEFFERSON HOSPITAL

HOWARD H BRADSHAW and GEORGE WILLAUER—2 Operative clinic Thoracic diseases

PENNSYLVANIA HOSPITAL

JOHN B FLICK and staff—9 Operative and dry clinic

JOHN T BAUER—3 Dry clinic Carcinoma of the lung diagnosis by sputum examination

PROTESTANT EPISCOPAL HOSPITAL

RICHARD H MEADE JR—9 Operative and dry clinic Thoracoplasty for pulmonary tuberculosis

Thursday

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

J W CUTLER—2 Operations Extrapleural and intrapleural pneumolysis in surgical therapy of tuberculosis

TEMPLE UNIVERSITY HOSPITAL

W EMORY BURNETT—9 Operative clinic

Staff—2 Dry clinic Thoracic diseases (chest conference)

BRONCHO-ESOPHAGOGY

(See also clinical schedules under Otorhinolaryngology)

Monday

TEMPLE UNIVERSITY HOSPITAL

CHEVALIER L JACKSON and staff—1 Broncho esophageal clinic Bronchoscopy as an aid to the thoracic surgeon

Tuesday

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

GABRIEL TUCKER WILLIAM A LELL and J P ATKINS—9 Direct laryngoscopy

GABRIEL TUCKER—2 Dry clinic Laryngeal tumors benign and malignant demonstration of patients and colored motion pictures on the technique of direct laryngoscopy laryngofissure and laryngectomy

JEWISH HOSPITAL

LOUIS H CLERF R M LUKENS and C J SWALK—3 Bronchoscopic clinic

PHILADELPHIA GENERAL HOSPITAL

GEORGE L WHELAN—9 Bronchoscopic clinic

PROTESTANT EPISCOPAL HOSPITAL

WILLIAM A LELL—2 Bronchoscopic clinic Motion picture demonstration The Larynx

TEMPLE UNIVERSITY HOSPITAL

CHEVALIER L JACKSON—11 Dry clinics Diseases of the esophagus diverticulum of the hypopharynx and one stage operation for its surgical cure (motion pictures)

Wednesday

JEFFERSON HOSPITAL

LOUIS H CLERF—9 Bronchoscopic clinic

MISERICORDIA HOSPITAL

GABRIEL TUCKER JOSEPH P ATKINS, and WILLIAM A LELL—2 Operative and dry clinic

MOUNT SINAI HOSPITAL

W A LELL and staff—10 Operative and dry clinic

PHILADELPHIA GENERAL HOSPITAL

LOUIS H CLERF—1 Bronchoscopic clinic Malignant tumors

WOMAN'S MEDICAL COLLEGE HOSPITAL

EMILY VAN LOON and associates—9 Bronchoscopic clinic

Thursday

FRANKFORD HOSPITAL

GEORGE A. RICHARDSON—1:30 Bronchoscopic clinic

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

GABRIEL TUCKER, WILLIAM A. LELL and J. P. ATKINS—9
Bronchoscopic clinic

JEFFERSON HOSPITAL

LOUIS H. CLERF—1 Bronchoscopic clinic

NORTHERN LIBERTY HOSPITAL

N. M. LEVIN—9 Bronchoscopic clinic

PHILADELPHIA GENERAL HOSPITAL

LEONARD I. WITFLAN—9 Bronchoscopic clinic

ST. CHRISTOPHER'S HOSPITAL

1 MILLS and L. GON—9 Bronchoscopy in allergic children

TEMPLE UNIVERSITY HOSPITAL

CHEVALIER L. JACKSON and staff—2:30 Broncho esophagological clinic 4:30 Chest conference

U. S. NAVAL HOSPITAL

F. HARBERT—2 Bronchoscopic clinic

Friday

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

GABRIEL TUCKER and WALTER E. LEE—10 Surgical management of esophageal diverticula

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

GABRIEL TUCKER, WILLIAM A. LELL and J. P. ATKINS—9
Bronchology and esophagology

TEMPLE UNIVERSITY HOSPITAL

CHEVALIER L. JACKSON and WILLIAM A. SWALM—17
Gastroscopic clinic

OTORHINOLARYNGOLOGY

(See also clinical schedules under Broncho Esophagology)

Monday

BRYAN MAWR HOSPITAL

EDWIN P. LONGAKER—2 Operations

CHILDREN'S HOSPITAL

WILLIAM HEWSON—7 Dry clinic Sinus infections in children diagnosis and treatment

LOYD S. HUTCHINSON and MALCOLM N. WILMES—3
Operations Tonsillectomy in children

DELAWARE COUNTY HOSPITAL

FRANK O. HENDRICKSON—2 Operations

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

RALPH BUTLER and WALTER ROBERTS—2 Operative and dry clinic

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

HARRY I. SCHENCK and JULIUS SILCOX—2 Operations
Staff—2 Dry clinic

DELAWARE HOSPITAL Notes on septal surgery

JULIUS WINSTON Neuro otological clinic

J. E. SILCOX Subluxation of the nasal septum

J. C. DONNELLY Audible tinnitus presentation of patients

H. P. SCHENCK Carcinoma of the nasal septum

KARL M. HILSEY Submucous resection of the nasal septum

JEWISH HOSPITAL

H. M. GODDARD—2 Operations Submucous resection tonsillectomy maxillary sinus

MOUNT SINAI HOSPITAL

M. S. ERBNER—2:30 Operations

PENNSYLVANIA HOSPITAL

WILLIAM HEWSON and THOMAS COWEN—2 Operations
EDWARD H. CAMPBELL—2 Diagnostic methods in nose and throat conditions

PHILADELPHIA GENERAL HOSPITAL

HERBERT M. GODDARD—2 Tonsil and submucous clinic

KESBYTTRIAN HOSPITAL

WALTER L. CARIS, DOUGLAS MACFARLAN, RICHARD W. CARLICH and I. W. KEMNER—2 Operative and dry clinic

ST. JOSEPH'S HOSPITAL

T. J. COWEN—1 Operative and dry clinic

ST. MARY'S HOSPITAL

I. J. MURPHY—1 Operations

TEMPLE UNIVERSITY HOSPITAL

ROBERT F. RIDPATH and staff—2 Rhinological clinic

WOMAN'S HOSPITAL OF PHILADELPHIA

HENRIETTA T. TANNER—2 Operations Tonsillectomy and adenoidectomy

Tuesday

COOPER HOSPITAL

ORAM K. KLINE, ERNEST R. HIRST and staff—2 Operations

DELAWARE COUNTY HOSPITAL

W. K. KISTLER—2 Operative and dry clinics

FITZGERALD MERCY HOSPITAL

CORNELIUS T. MCCARTHY—1 Radical mastoidectomy report on three cases of lateral sinus thrombosis with recovery Treatment of otolaryngological cases with sulfanilamide

FRANKFORD HOSPITAL

ROBERT WATT—1:30 Operative and dry clinic

GERMANTOWN HOSPITAL

H. J. WILLIAMS, C. B. OWINGS, C. E. TOWSON and VALE TINE MILLER and WILLIAM HITSCHLER—2 Operative and dry clinic

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

GEORGE M COATES and BENJAMIN H SHUSTER—2
Operative and dry clinics Otolaryngology and neuro
otology
GEORGE B WOOD—2 Operative and dry clinic

HAHNEMANN HOSPITAL

CHARLES B HOLLIS—2 Operations

HOSPITAL FOR DISEASES OF STOMACH

ROBERT J HUNTER—2 Functional ear test

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

GABRIEL TUCKER WILLIAM A LELL and J P ATKINS—9
Direct laryngoscopy
JULIUS WINSTON and D S BOSTWICK—2 Operations
GABRIEL TUCKER—2 Dry clinic Laryngeal tumors
benign and malignant demonstration of patients and
colored motion pictures on the technique of direct
laryngoscopy laryngofissure and laryngectomy
Staff—2 Dry clinic Surgical treatment of deafness
EDWARD H CAMPBELL New surgical treatment of con
ductive deafness
OSCAR BATSON Anatomical considerations
WALTER HUGHSON Surgery of deafness
JAMES A BABBITT Newer phases of otosclerosis
D W BRONK Excitation of sensory nerves by normal
and pathological processes

JEFFERSON HOSPITAL

LOUIS H CLERY—9 Cancer of larynx
H H LOTT—9 Tonsil clinic
H J WILLIAMS—1 Dry clinic Facial paralysis occurring
during the course of chronic suppurative otitis media
and its treatment

LANKENAU HOSPITAL

EDWARD H CAMPBELL—2 Otolaryngological clinic

METHODIST EPISCOPAL HOSPITAL

WALTER ROBERTS and staff—2 Operations

MISERICORDIA HOSPITAL

R J BRENNAN—2 Lecture Treatment of sinusitis

MOUNT SINAI HOSPITAL

D N HUSIK—1 30 Operations

PENNSYLVANIA HOSPITAL

ORAM KLINE HENRY A MILLER and HOWARD HEBBLE—
2 Operations
ROMEO A LUONGO and ANTHONY C BRANCATO—2 Dry
clinic Diagnostic methods in nose and throat condi
tions
LOUIS E SILCOX—2 Operations Tonsillectomy general
anesthesia

PHILADELPHIA GENERAL HOSPITAL

LOUIS J BURNS—2 Laryngeal tuberculosis

ST JOSEPH'S HOSPITAL

ARTHUR WRIGLEY—11 Operative and dry clinic

ST LUKE'S AND CHILDREN'S HOSPITAL

SETH BRUMM and staff—2 Operative clinic

ST MARY'S HOSPITAL

W P GRADY—9 Operative and dry clinic

TEMPLE UNIVERSITY HOSPITAL

MATTHEW S ERSNER EDWARD K MITCHELL S BRUCE
GREENWAY and DAVID MYERS—2 Otolological clinic

WEST JERSEY HOMOEOPATHIC HOSPITAL

E S HALLINGER and staff—2 Operations

Wednesday

CHESTNUT HILL HOSPITAL

JOHN R DAVIES JR GEORGE T FARIS and DARIUS C
ORNSTON—1 30 Operations

CHILDREN'S HOSPITAL

F HAROLD KRAUSS—1 Sinus infections in children
diagnosis and treatment tonsil and mastoid operations

FITZGERALD MERCY HOSPITAL

J E LOFTUS—1 Mastoid operations

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

RALPH BUTLER and WALTER ROBERTS—2 Operative and
dry clinic

HAHNEMANN HOSPITAL

JOSEPH V CLAY—2 Operations

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

EDWARD H CAMPBELL and O V BATSON—2 Operations
Staff—2 Dry clinic Chemotherapy in otolaryngology
D SERGEANT PEPPER Limitations of chemotherapy
H F FLIPPIN Chemotherapy in meningitis
THOMAS FITZ HUGH JR Hematological effects of drug
therapy
HARRY P SCHENCK Procedures supplementing chemo
therapy
KARL M HOUSER Chemotherapy in otolaryngology
E P PENDERGRASS Effects of chemotherapy upon
roentgenological findings

JEFFERSON HOSPITAL

A T SMITH—10 Tumors of nose and sinuses
H J WILLIAMS—1 Operative and dry clinic

JEWISH HOSPITAL

A S KAUFMAN—1 Mastoid operations

MISERICORDIA HOSPITAL

C T MCCARTHY—2 Operations Tonsillectomy, local
LaForce dissection submucous resection simple and
radical mastoid results of sulfanilamide in mastoiditis
GABRIEL TUCKER JOSEPH P ATKINS and WILLIAM A
LELL—2 Operative and dry clinic

PHILADELPHIA GENERAL HOSPITAL

ROBERT J HUNTER—2 Recent advances of otology

PROTESTANT EPISCOPAL HOSPITAL

ALLEN BERTOLET and staff—2 Operations

ST CHRISTOPHER'S HOSPITAL

HAROLD KRAUSS and GOMER T WILLIAMS—2 Operations

ST JOSEPH'S HOSPITAL

R L DICKSON—11 Operations

ST LUKE'S AND CHILDREN'S HOSPITAL

GEORGE MACKENZIE and staff—2 Demonstration of
cases Radical mastoids

STATE ZEPHYRUS HOSPITAL

STETSON HOSPITAL

C H GRIMES and staff—12 Operative and dry clinic

TEMPLE UNIVERSITY HOSPITAL

ROBERT F RIDPATH and staff—2 Rhinological clinic

WEST JERSEY HOMIOPATHIC HOSPITAL

E S HALLINGER and staff—2 Operations

WOMAN'S HOSPITAL OF PHILADELPHIA

CATHERINE ARTURS and staff—2 Operations

Thursday

ABINGTON MEMORIAL HOSPITAL

WALTER HUGHSON—3 Demonstration of the physiology of hearing

BRYN MAWR HOSPITAL

CHARLES A PRYOR—2 Operations

CHESTNUT HILL HOSPITAL

B D PARISH and FRED F TRAGANZA—2 Operations

FITZGERALD MERCY HOSPITAL

CORNELIUS T MCCARTHY—1 Operations

GERMANTOWN HOSPITAL

H J WILLIAMS C B OWINGS C E FOWSON VALENTINE MILLER and WILLIAM HITSCHLER—2 Operations

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

GABRIEL TUCKER WILLIAM A LELL and J I ATKINS—9 Bronchoscopic clinic

GEORGE M COATES and B H SHUSTER—2 Operative and dry clinics Otolaryngology and neuro-otology
GEORGE B WOOD—2 Operative and dry clinic

HAINLMANN HOSPITAL

CHARLES B HOLLIS—2 Operations

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

J C DONNELLY and H SCHLUDERBERG—2 Operations
Staff—2 Dry clinic

VALENTINE MILLER Demonstration Loose areolar tissue of the larynx

J C DONNELLY Allergy of the upper respiratory tract and its relation to bronchiectasis

FREDERICK H KRAUSS New method of tonsillectomy under inethene anesthesia

ROBERT J HUNTER Interpreting tuning fork time in decibels

FRANCIS C GRANT Otic brain abscess

ELLIOTT CLARK and RICHARD ABELL Studies of reactions in living tissue

JEFFERSON HOSPITAL

A T SMITH—9 Tonsil clinic

A T SMITH—1 Sinus clinic

JEWISH HOSPITAL

H B COHEN—1 Operations

MEMORIAL HOSPITAL

H J WILLIAMS—2 Radical mastoid operations

METHODIST EPISCOPAL HOSPITAL

WALTER ROBERTS and staff—2 Operations

MISERICORDIA HOSPITAL

J I LOFTUS—2 Dry clinic Mastoid surgery

MOUNT SINAI HOSPITAL

MORRIS A WEINSTEIN—2 Operations

PENNSYLVANIA HOSPITAL

WILLIAM HEWSON ORAM KLINE and ROMEO LONGO—2 Operations

WILLIAM HEWSON HOWARD HEBBLE and LOUIS E SILCOV—2 Dry Clinic Diagnostic methods in nose and throat conditions

EDWARD H CAMPBELL—2 Mastoid operations

PHILADELPHIA GENERAL HOSPITAL

BENJAMIN H SHUSTER—2 Laryngeal tuberculosis

PROTESTANT EPISCOPAL HOSPITAL

OTTO C HIAST and staff—2 Operations

ST LUKE'S AND CHILDREN'S HOSPITAL

WILLIAM WHELAN BENJAMIN SHUSTER and staff—2 Lantern slide demonstration showing patients before and after radical operation for disease of the frontal ethmoid and maxillary sinuses with proptosis of the eye ball

ST MARY'S HOSPITAL

J J HOLLAND—2 Operative and dry clinic

TEMPLE UNIVERSITY HOSPITAL

CHEVALIER L JACKSON and W WAYNE BABCOCK—1 Dry clinic Surgical treatment of cancer of the larynx laryngofissure and laryngectomy

V M LEVIN—1 Teaching the laryngectomized patient to talk

MATTHEW S ERSNER and staff—2 Otolological clinic Demonstration of cases where labyrinthian fenestrations were performed for the relief of deafness

U S NAVAL HOSPITAL

T S MORING C W STELLE and F HARBERT—9 Operative and dry clinic

Friday

CHILDREN'S HOSPITAL

EDWARD H CAMPBELL—1 Sinus infections in children diagnosis and treatment, mastoid operations

FITZGERALD MERCY HOSPITAL

J E LOFTUS—1 Operations

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

GABRIEL TUCKER and WALTER E LEL—10 Surgical management of esophageal diverticula

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

GABRIEL TUCKER WILLIAM A LELL and J P ATKINS—9 Bronchology and esophagology
KARL M HOUSER and E W KEMNER—2 Operations

LANCENAL HOSPITAL

EDWARD H CAMPBELL—2 Otolaryngological clinic

PENNSYLVANIA HOSPITAL

THOMAS GOWEN and HENRY A. MILLER—2 Operations
 THOMAS GOWEN and EDWARD J. GOUGH—2 Dry clinic
 Diagnostic methods in nose and throat conditions
 THOMAS GOWEN and WILLIAM DANENOWER—2 Opera-
 tions Tonsillectomy and mastoidectomy

PHILADELPHIA GENERAL HOSPITAL

DAVID N. HUSIA—2 Operative and dry clinic

ST CHRISTOPHER'S HOSPITAL

HAROLD KRAUS and COMER T. WILLIAMS—10 Opera-
 tions

ST MARY'S HOSPITAL

T. J. WALSH—1 Operative and dry clinic

WOMEN'S HOMEOPATHIC HOSPITAL

J. R. CRISWELL—2 Radical mastoid operation

OPHTHALMOLOGY

Monday

COOPER HOSPITAL

J. S. SHIPMAN and staff—2 Operations

GRADUATE HOSPITAL OF UNIVERSITY
OF PENNSYLVANIA

L. C. PETER and staff—2 Dry clinic

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

FRANCIS HEED ADLER—2 Operative and dry clinic

JEFFERSON HOSPITAL

C. E. G. SHANNON—2 Operative and dry clinic

LANKENAU HOSPITAL

PERCE DE LONG—2 Ophthalmological clinic

MOUNT SINAI HOSPITAL

AARON BARLOW—4 Operations

IENNNSYLVANIA HOSPITAL

A. G. FEWELL—2 Fundus clinic

PRESBYTERIAN HOSPITAL

H. M. LANGDON—2 30 Operative and dry clinic

PROTESTANT EPISCOPAL HOSPITAL

ANDREW KNOX—2 Operative and dry clinic

ST CHRISTOPHER'S HOSPITAL

J. B. FELDMAN—2 Squint clinic

TEMPLE UNIVERSITY HOSPITAL

WALTER I. LILLIE and staff—1 Operative and dry clinic

WILLS HOSPITAL

J. M. GRISCOM, F. C. PARKER and T. A. O'BRIEN—2
 Operative and dry clinic

Tuesday

CHESTNUT HILL HOSPITAL

GEORGE E. BERNER—2 Operations

GRADUATE HOSPITAL OF UNIVERSITY
OF PENNSYLVANIA

WILLIAM T. SHOFMAKER—2 Operative and dry clinic

HOSPITAL FOR DISEASES OF STOMACH

GEORGE H. DENNEY—1 Cataract cases

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

ROBB McDONALD—10 Dark adaptation

JEFFERSON HOSPITAL

C. E. G. SHANNON—2 Operative and dry clinic

PHILADELPHIA GENERAL HOSPITAL

C. R. MULLEN—3 Operative and dry clinic

PROTESTANT EPISCOPAL HOSPITAL

N. M. BRINKERHOFF—2 Operative and dry clinic

ST CHRISTOPHER'S HOSPITAL

J. B. FELDMAN—2 Squint clinic

ST LUKE'S AND CHILDREN'S HOSPITAL

F. C. PETERS, S. H. BROWN and staff—2 Operative clinic

ST MARY'S HOSPITAL

F. A. MURPHY—1 Operative and dry clinic

TEMPLE UNIVERSITY HOSPITAL

WALTER I. LILLIE and staff—1 Operative and dry clinic

WILLS HOSPITAL

I. S. TASSMAN—9 Refraction orthoptics

PERCE DE LONG—9 Pathological laboratory

Inspection of hospital—9 and 2 Superintendent and
 assistant

LOUIS LEHRFELD, W. S. REESE and C. R. MULLEN—2
 Operative and dry clinic

E. W. SPACKMAN—2 X-ray clinic

I. S. TASSMAN—2 Refraction, orthoptics

PERCE DE LONG—2 Pathological laboratory

Wednesday

BRYN MAWR HOSPITAL

T. DELORME FORDYCE—2 Operative and dry clinic

GRADUATE HOSPITAL OF UNIVERSITY
OF PENNSYLVANIA

L. C. PETER and staff—2 Operations

GERMANTOWN HOSPITAL

CARL WILLIAMS and ALBERT C. SAUTTER—10 Operations

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

FRANCIS HEED ADLER—2 Operative and dry clinic

JEFFERSON HOSPITAL

C. E. G. SHANNON—2 Operative and dry clinic

LANKENAU HOSPITAL

PERCE DE LONG—2 Ophthalmological clinic

PRESBYTERIAN HOSPITAL

H M LANGDON—2 30 Operative and dry clinic

PROTESTANT EPISCOPAL HOSPITAL

ANDREW KNOW—2 Operative and dry clinic

ST CHRISTOPHER'S HOSPITAL

J B FELDMAN—3 Operations

ST LUKE'S AND CHILDREN'S HOSPITAL

F C PETERS S H BROWN and staff—2 Operative clinic

WILLS HOSPITAL

I S TASSMAN—9 Refraction orthoptics

PERCE DE LONG—9 Pathological laboratory

Inspection of hospital—9 and 2 Superintendent and assistant

JAMES S SHIPMAN EDMUND B SPAETH and WILLIAM J

HARRISON—2 Operative and dry clinic

E W SPACKMAN—2 X ray clinic

I S TASSMAN—2 Refraction orthoptics

PERCE DE LONG—2 Pathological laboratory

Thursday

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

WILLIAM T SROEMAKER—2 Operative and dry clinic

JEFFERSON HOSPITAL

C E G SHANNON—2 Operative and dry clinic

MOUNT SINAI HOSPITAL

AARON BARLOW—4 Operations

PHILADELPHIA GENERAL HOSPITAL

C R MULLEN—3 Operative and dry clinic

PROTESTANT EPISCOPAL HOSPITAL

A M BRINCKERHOFF—2 Operative and dry clinic

ST CHRISTOPHER'S HOSPITAL

J B FELDMAN—2 Squint clinic

ST LUKE'S AND CHILDREN'S HOSPITAL

F C PETERS S H BROWN and staff—9 Operations

ST MARY'S HOSPITAL

R T M DONNELLY—10 Operations

TEMPLE UNIVERSITY HOSPITAL

WALTER I LILLIE and staff—1 Operative and dry clinic

U S NAVAL HOSPITAL

T S MORING C W STELLF and F HARBERT—9 Operative and dry clinic

WILLS HOSPITAL

I S TASSMAN—9 Refraction orthoptics

PERCE DE LONG—9 Pathological laboratory

Inspection of hospital—9 and 2 Superintendent and assistant

J M GATCOM F C PARKER and T A O BRIEN—2 Operative and dry clinic

E W SPACKMAN—2 X ray clinic

I S TASSMAN—2 Refraction orthoptics

PERCE DE LONG—2 Pathological laboratory

Friday

GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

L C PETER and staff—2 Dry clinic

HIMMELMANN HOSPITAL

FREDERICK C PETERS and staff—2 Operations

HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

FRANCIS REED ADLER—2 Operative and dry clinic

JEFFERSON HOSPITAL

C E G SHANNON—2 Operative and dry clinic

PENNSYLVANIA HOSPITAL

A G FENWELL—2 Fundus clinic

PRESBYTERIAN HOSPITAL

H M LANGDON—2 30 Operative and dry clinic

PROTESTANT EPISCOPAL HOSPITAL

ANDREW KNOW—2 Operative and dry clinic

ST CHRISTOPHER'S HOSPITAL

J B FELDMAN—2 Squint clinic

ST JOSEPH'S HOSPITAL

THOMAS O BRIEN—4 Operative and dry clinic

TEMPLE UNIVERSITY HOSPITAL

WALTER I LILLIE and staff—1 Operative and dry clinic

WILLS HOSPITAL

I S TASSMAN—9 Refraction orthoptics

PERCE DE LONG—9 Pathological laboratory

Inspection of hospital—9 and 2 Superintendent and assistant

LOUIS LEHRFELD W S REESE and C R MULLEN—2 Operative and dry clinic

E W SPACKMAN—2 X ray clinic

I S TASSMAN—2 Refraction orthoptics

PERCE DE LONG—2 Pathological laboratory

WOMEN'S HOMOEOPATHIC HOSPITAL

C J V FRIES—2 Dry clinic Traumatic eye injuries and infections

1000



Copyright © 1939

HARVEY CUSHING

APRIL 8 1869—OCTOBER 7 1939

SURGERY

GYNECOLOGY AND OBSTETRICS

An International Magazine, Published Monthly

VOLUME 69

NOVEMBER, 1939

NUMBER 5

ENDOMETRIOSIS OF THE LUNGS

Experimental Production of Endometrial Transplants in the Lungs of Rabbits

JOHN F. HOBBS, M.D., and A. R. BORTNICK, M.D.,
St. Louis, Missouri

FOR several years the senior author (7) has stated repeatedly that he surmised fragments of endometrial tissue were transported through the lymphatics and venous channels to the lungs, became embedded there and grew. This idea seems logical in view of several known facts.

In the first place, experimental autotransplantation of endometrial tissue has been made to various structures such as ovaries, tubes, abdominal wall, cornea of the eye, etc. Inadvertently during laparotomies, endometrial tissue has been transplanted to the uterine wall, tubal stump, and abdominal wall. Furthermore, Jacobson and others have shown that fragments of menstruating endometrium can be autotransplanted, thus showing the viability of mucosal tissue cast off at menstruation. It seems to be the consensus now, that Sampson's (5) theory of regurgitation of menstrual blood through the tube is responsible for the major source of pelvic endometriosis. Fragments of mucosa become implanted on the ovaries and form chocolate cysts which may rupture and further dis-

seminate endometrial tissue throughout the lower abdomen. The diversity of structures in which endometrial tissue has been found, namely, vulva, vagina, inguinal region, uterus, tubes, ovaries, rectovaginal septum, intestinal tract, umbilicus, laparotomy scars, thighs, etc., would indicate that the lungs do not have any special resistance to the growth of this tissue. In the second place, Sampson (6), Halban, and others have demonstrated the presence of uterine mucosa in veins and lymphatic vessels. This is the logical, though not the only, explanation for the presence of this tissue in the inguinal nodes and vulva. No other theory could possibly serve to explain the occurrence of endometrium in the brachioradialis muscle and thigh as reported by Navratil and Kramer, and by Mankin, respectively. In these 2 cases the fragments of endometrium would have to progress through the capillary bed in the lungs or pass from the right to the left heart through a patent foramen ovale.

In addition, pathologists occasionally find innocuous, normal syncytial cells in the lung tissue of women who have died during pregnancy or childbirth. It is also significant that in chorionepithelioma one of the first sites of

From the Department of Obstetrics and Gynecology, Washington University School of Medicine, the St. Louis Maternity Hospital and Barnes Hospital, St. Louis, Missouri.

metastasis is to the lungs. This is *prima facie* evidence that cells from the uterus can reach the lungs through the blood and lymphatic channels. Is there any reason why endometrial tissue cannot be transported in the same way? Might not aberrant endometrial tissue be the explanation for so called vicarious menstruation? Is it possible that ectopic endometrial tissue is the origin of heretofore unrecognized benign and malignant tumors of the lungs?

The desire to confirm our suspicion was crystallized by an interesting case observed by one of us (J. I. H.)

A woman 42 years of age complained of a small mass in one inguinal region which became larger and painful at the time of menstruation. In addition she complained of hemoptysis often associated with the menstrual period. The inguinal mass was diagnosed as an incarcerated omental hernia. The mass was explored and found to consist of large lymph nodes. These nodes were removed and microscopic examination showed them to contain endometrial tissue. Thereupon it was suggested that the hemoptysis might be due to an endometrial implant in the lungs. This suggestion was considered whimsical by some of our colleagues. We conveyed our suggestion to our chief, Dr. Otto H. Schwarz, who thought our idea meritorious. He encouraged us to study the case further and to carry out some experimental work. Roentgenograms of the lungs showed a circumscribed shadow in the apex of the right lung. There was no clinical or definite x-ray evidence of tuberculosis. Repeated sputum examinations showed no tubercle bacilli. This small shadow then was considered by us possibly to be endometrial tissue. The patient refused to have a bronchoscopic examination and biopsy of the area. Some dilated veins were found in the pharynx but never any evidence of bleeding. She was given a sterilizing dose of x-rays to the ovaries in order to destroy hormone elaboration and thereby check the growth of the ectopic endometrium in the inguinal nodes. Since that time the patient has had cessation of menstruation and the groin has been free of tumors. Repeated x-ray plates of the chest have not revealed any appreciable change in the size of the aforementioned shadow. She occasionally has hemoptysis usually associated with excitement. Repeated examinations have failed to show any evidence of tuberculosis.

Whether this case was one of endometrial transplant in the lung or not, is a matter of conjecture. Nevertheless it stimulated our interest enough to attempt the transplantation of endometrial tissue into the lungs of a laboratory animal.

TECHNIQUE

In our original plan we decided to remove the uterus of the guinea pig, scrape away the endometrium, and transplant the tissue directly into the lung substance. We abandoned this plan without a single trial, for the obvious reason that the surgical shock of removal of the uterus and transplantation of the mucosa into the lung would almost surely kill the animal. Then we decided to remove the uterus, curette away the endometrium, grind it with a pestle and mortar, suspend the tissue in normal saline solution, and inject it into the lung tissue and pleural cavity. The uncertainty of placing the tissue in the desired location caused us to discard this plan of attack. Next we actually attempted to inject this suspended tissue into the inferior vena cava. The vein was difficult to isolate, very fragile and after removal of the needle, bleeding could not be controlled. In addition considerable time was consumed in the abdominal cavity along with some traumatization which helped to dispatch the animals. Out of this maelstrom of ideas we evolved the technique followed in these experiments.

Large rabbits weighing 2,000 grams were used. Each of them was given 2,000 units of theelin intramuscularly 2 or 3 days prior to the operation in order to stimulate the endometrium to proliferate. The rabbits were given nembutal rectally in doses of 0.18 gram for analgesia and only small amounts of ether by inhalation were found necessary for the operation. A small portion of each horn, together with the uterus was removed. While one operator ligated the pedicles and closed the abdominal wall, the other prepared the endometrial tissue curetted from the uterus. The tissue was ground up, suspended in normal saline and injected into the ear vein. A No. 18 gauge needle was used and surprisingly large pieces of tissue could be forced through the lumen. This method has several advantages that are worth recounting. A large rabbit has a comparatively large uterus which facilitates the technical part of the hysterectomy. It is obvious that more endometrial tissue is available. The pre-operative administration of theelin enhanced the growth of the endometrium and thereby facilitated



Fig 1



Fig 2



Fig 3

Fig 1. Rabbit 1981. A shows a small vein with typical endometrial stromal cells in the wall.

Fig 2. Rabbit 1944. The left lung shows numerous grayish white patches which are not inflammatory in character. They are considered most likely to be endometrial

stromal cells and fragmented endometrium but not definite in character.

Fig 3. Rabbit A 7. The thrombosed vessel shows fragments of epithelial tissue that are growing in the organized tissue.

denudation. The time consumed and trauma done in performing the hysterectomy was minimal, indeed. The injection of saline suspended endometrium into the ear vein is a very simple procedure and can be done with precision. The destination of the tissue is exactly the same as if it were injected into the inferior vena cava, namely, the right heart. From the right auricle it goes to the right ventricle and from there, through the pulmonary arteries to the lungs. A diffuse dissemination is insured.

A summary of the pathological findings follows.

PATHOLOGICAL EXAMINATION

Rabbit 1980. *Gross description*. Both lungs presented the same appearance. There were two or three hemorrhagic areas in the upper lobes. *Microscopic description*. No evidence of endometrial tissue. Some chronic passive congestion.

Rabbit 1981. *Gross description*. Both lungs showed several small grayish patches. *Microscopic description*. Left lung was normal. Right lung showed cells characteristic of stromal cells in the lumen of the veins (Fig 1). No glandular epithelium was present.

Rabbit 1944. *Gross description*. The right lung had a mottled appearance. The middle lobe contained grayish white spots which were quite well demarcated (Fig 2). The left lung showed numerous grayish patches which were confluent. They stood out in relief against the normal lung tissue.

Microscopic description. There were numerous small areas of necrosis. Some areas showed cells alien to the lungs which were not inflammatory cells. They may be endometrial stroma cells and fragmented epithelium but one cannot be certain.

Rabbit A 6. *Gross description*. Both lungs showed areas of grayish spots with a few reddish areas. *Microscopic description*. Both lungs appeared normal with the exception of some chronic passive congestion. No evidence of endometrial tissue.

Rabbit A 7. *Gross description*. The right lung had a grayish appearance. There were some irregular reddish brown areas. There was a small amount of fibrinous exudate over the lower lobe. The left lung was covered by a fibrinous exudate. In the upper lobe there was a firm, irregular, white nodule, measuring 1.5 centimeters in diameter. On the posterior surface of the lower lobe was a small round bluish area.

Microscopic description. The right lung showed marked extravasation of blood. There was no evidence of infection. The left lobe showed areas of necrosis. One thrombosed vessel showed fragmented glandular tissue (Fig 3).

Rabbit A 8. *Gross description*. The posterior surface of the lower lobe of the right lung showed numerous grayish patches, many of which had a beaded appearance. The posterior surface of the left lung showed areas of bluish discoloration. There were two small hemorrhagic areas in the upper portion of the lower lobe. *Microscopic description*. Neither lung showed any evidence of endometrial tissue.

Rabbit A 9. *Gross description*. The right lung was covered by a white fibrinous exudate. The lower lobe showed a number of small, hard, white nodules. The left lung was also covered by a fibrinous exudate. The lower lobe showed a number of white



Fig 4 left Rabbit A 9 A diffuse distribution of endometrial stromal cells

Fig 5 Same rabbit High power of section shown in Figure 4

areas which had a tendency to be confluent. *Microscopic description* The right lung showed numerous necrotic areas. One area showed fragmented epithelial tissue. One section through the left lung showed numerous strands of endometrial stromal cell about the capillaries (Figs 4 and 5). Another section showed a large blood vessel lined with low cuboidal epithelium.

Rabbit A 10 *Gross description* The right lung showed some fibrinous exudate over the surface and numerous grayish white patches throughout. The left lung showed a fibrinous exudate over the surface. Both lobes showed localized patches of grayish and chocolate colored areas. *Microscopic description* Both lungs showed numerous areas of necrosis.



Fig 6 Rabbit A 10 A large blood vessel which is partially occluded by an organized thrombus which contains glandular tissue

One section through the right lung showed a blood vessel in which there was an organized thrombus containing one endometrial gland intact and another one which was fragmented (Fig 6).

Rabbit A 19 *Gross description* Over the surface of the right lung there were several gray and some brownish red spots. The anterior surface of the left lung showed some fibrinous exudate. In the lower lobe was a dark area measuring 1.5 centimeters in width. The posterior surface showed evidence of a fibrinous exudate. The lower two third of the lower lobe was a chocolate color. Near the medial border was a cyst 1.5 centimeters in diameter. The cavity contained a small amount of thick chocolate like material (Fig 7). *Microscopic description* One section through the right lung showed a blood vessel containing some debris and several cells resembling endometrial stroma. Sections through the left lung showed blood vessels which contained endometrial glands and stroma (Figs 8, 9, 10, 11 and 12).

Rabbit A 23 *Gross description* The upper lobe of the left lung was consolidated. There were numerous areas of grayish discoloration. The lower lobe showed a number of hemorrhagic areas. There were also numerous grayish nodules. The upper lobe of the right lung was occupied by white hard nodules. There were hemorrhagic areas throughout the remainder of the lung. *Microscopic description* The right lung showed no typical muellerian epithelium. The left lung showed several of the bronchi filled with nondescript debris. One region showed numerous small glands which were not bronchioles and are therefore considered to be endometrial in origin although they are not characteristic (Figs 13 and 14).

Only two or three blocks were taken from suspicious areas in each lung. Had we taken numerous or serial sections, perhaps the frequency would have been greater than we have recorded. We were interested to show that



Fig 7

Fig 7 Rabbit A 19 Note the cystic cavity which was filled with a chocolate like material



Fig 8

Fig 8 Same rabbit A thrombosed blood vessel which



Fig 9

shows the presence of glandular tissue that is growing in it

Fig 9 Same rabbit A high power magnification of Figure 8

the tissue would grow in the lung and one case sufficed, therefore, we have made no effort to demonstrate extensive dissemination or frequency of implantation

As controls we studied the lungs of 10 normal rabbits, used in the Friedman test for pregnancy. All of these showed normal lung tissue

PURPOSE OF STUDY

The primary purpose of this investigation was to establish the fact that autotransplanted endometrial tissue would grow in the lungs. This we have demonstrated. These experiments have also revealed that endometrial tissue can be transported through the veins to the lungs. We have already pointed out



Fig 10

Fig 10 Same rabbit Another thrombosed vessel containing glands surrounded by endometrial stroma. The tissue has extended through the wall of the vessel

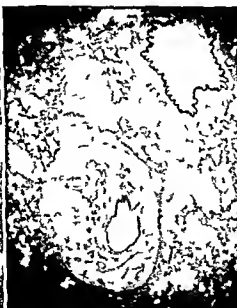


Fig 11

Fig 11 Same rabbit Still another thrombosed vessel



Fig 12

showing the presence of a diffuse growth of epithelium and stroma

Fig 12 Same rabbit A high power of the large gland in Figure 11



Fig. 13 left Rabbit V 23 The large glandular structure is a bronchiole filled with inflammatory exudate Outside of this one can see numerous small glands which are not typically endometrial but are alien to the lung

Fig. 14 Same rabbit A high power photomicrograph showing the character of the glands described in Figure 13

that endometrial tissue has been demonstrated in the lumina of veins and lymphatics by other investigators and an abundance of information has been recorded from which one can logically deduce that uterine mucosal tissue must be transported through the lymph and blood vascular systems With the fact unequivocally established that endometrial tissue is transported through the lymphatic and blood vascular systems, and that the tissue will grow in the lungs is it not logical to assume that uterine mucosa does occasionally become implanted in the lungs? Is it not also plausible that this tissue might rarely be found in any organ in the body since it may get into the left heart either by passing through a patent foramen ovale or by propagating through the capillaries of the lungs into the pulmonary veins and thence into the left heart?

With this possibility of wide dissemination in mind a credible theory for the explanation of vicarious menstruation becomes evident Vicarious menstruation may be due to endometrial transplants in the area from which the periodic bloody discharge issues In vicarious menstruation the bleeding usually takes place from the nose or some open sore though it may come from almost any mucous surface such as the lungs bladder rectum and stomach The axilla and groin may be affected Vicarious menstruation is very rare

and physicians who are fortunate enough to see accessible areas which have a discharge of blood associated with the menstrual period should make a detailed microscopic study and record the findings

Another interesting phase of this subject, which needs further investigation is the development of malignancy in ectopic tissue Aberrant endometrium shares with normal endometrium the capacity for becoming malignant The fact that this tissue has a lymphogenous and hematogenous distribution, its ability to invade by direct continuity not only the parent organ but any alien host and its proliferative activity in an ectopic existence, are characteristics which are common to malignant tissue We therefore suspect that this heterotopic tissue has a running start toward malignant development Many primary glandular carcinomas of the ovaries whose origin was formerly nebulous are now conceded to arise from endometrial implants This may apply in other locations Uterine mucosa may change its morphological aspects considerably in adapting itself to an ectopic environment One must be cognizant of this protean characteristic in order to recognize the tissue in its various aberrant locations This distortion is particularly noticeable in cancerous change

The mortality in our experiments was very great However, all of the rabbits lived 19

days and over. The explanation for this high mortality is obviously, due to the enormous amount of tissue injected into the veins. It was surprising that the animals were not dispatched immediately. The tissue spontaneously disseminated through the veins would be infinitesimal as compared to the large amounts injected in these experiments.

We shall report at a future date on some additional work we have started. We have done hysterotomies on several animals and have removed the mucosa and sutured the horns. The mucosal tissue has been injected into the ear vein. The animals will be bred. We hope to show a decidual reaction in the implants in the lungs.

CONCLUSIONS

A study of these experiments, clinical and pathological observation, and information gleaned from the literature, make the following conclusions seem evident:

- 1 Endometrial tissue is transported through lymphatics and veins.
- 2 Autotransplanted uterine mucosa of the rabbit will grow in the lung tissue.
- 3 With these two conclusions as a major premise, we can conclude that, therefore,

endometrial tissue must occasionally reach the lungs and grow.

4 A plausible explanation for vicarious menstruation is evident, since endometrial tissue can get into the general circulation either through a patent foramen ovale or by propagation through the pulmonary circulation.

5 This aberrant endometrial tissue has characteristics which would indicate it has increased potentiality to become malignant.

Dr Howard A. McCordock, late professor of pathology in the Washington University School of Medicine, gave valuable assistance in the microscopic study of these lung preparations.

BIBLIOGRAPHY

- 1 HALBAN, J. Metastatic hysteroadenosis. *Wien klin Wchnschr.* 1924, 37, 1205.
- 2 JACOBSON, V. C. Autotransplantation of endometrial tissue in rabbits. *Arch. Surg.*, 1922, 5, 281.
- 3 MARKIV, Z. W. Endometriosis of the thigh. *Arch. f. Gynaek.* 1935, 159, 671.
- 4 NAVRATIL, E. and KRAMER, A. Endometriosis of the arm. *Klin. Wchnschr.* 1936, 15, 1763.
- 5 SIMPSON, J. A. Peritoneal endometriosis due to menstrual dissemination of endometrial tissue into peritoneal cavity. *Tr. Am. Gynec. Soc.* 1927, 52, 171.
- 6 Idem. Endometrial tissue into the venous circulation. *Am. J. Path.* 1927, 3, 93.
- 7 SEELIG, M. G. and HOBBS, JOHN F. Endometriosis of the Vermiform Appendix. Festschrift dedicated to Robert Tilden Frank, June 1937. St. Louis: C. V. Mosby Co., 1937.

THE EFFECT OF OBSTETRICAL ANESTHESIA UPON THE OXYGENATION OF MATERNAL AND FETAL BLOOD WITH PARTICULAR REFERENCE TO CYCLOPROPANE

CLEMENT A. SMITH M.D. Boston, Massachusetts

In recent years asphyxia and atelectasis at birth have assumed primary importance among the causes of neonatal death. As the mortality from intracranial hemorrhage yields to obstetrical knowledge and skill, problems associated with respiration demand and are receiving increased attention. That this attention be based upon fundamental physiological facts is essential. Clinical observation and speculation are insufficient. Thus, after many years of observation theory and controversy in the literature, actual biochemical measurements such as those reported by Eastman (4) and his colleagues have offered for the first time a factual basis upon which an understanding of the onset of human respiration can be built.

These authors first described a simple technique for obtaining samples of umbilical cord blood representative of the arterial and venous sides of the infant's circulation at and even before delivery. Using this method they demonstrated that the fetus exists in utero at a low level of blood oxygenation and that this apparently physiological anoxemia may be considerably increased during labor so that at delivery the infant's blood is usually surprisingly deficient in oxygen. Moreover, they demonstrated that because of accumulation of lactic acid from the maternal organism, the newborn infant's blood is not only anoxic but also tends toward an acidosis and toward an increased carbon dioxide tension. These three factors, namely, anoxemia, acidosis, and increased carbon dioxide tension, Eastman showed to be present in still greater degree in infants presenting the clinical picture of asphyxia neonatorum.

That a disturbance of the respiratory physiology in mother and infant may result direct-

ly from maternal anesthesia at delivery was demonstrated in a fifth paper by Eastman (6) published in 1936. In this study, data were presented upon the cord bloods of infants born under chloroform, ether, and nitrous oxide-oxygen anesthetics. While in mothers receiving chloroform and ether the usual oxygenation of the fetal blood was unaffected, nitrous oxide-oxygen mixtures were regularly associated with some degree of abnormal anoxemia, moderate in the mother and relatively marked in the fetus. This state was augmented when stronger concentrations of nitrous oxide were administered to deepen the maternal anesthesia. When infants born to such mothers showed clinical asphyxia, their cord bloods presented levels of oxygen as low as 15 to 10.4 per cent of capacity.

It has been found the arterial blood of the normal adult is saturated to about 95 per cent of oxygen capacity, that of the fetus at birth about 50 per cent saturation. The author stressed the conclusion that asphyxia neonatorum is an example of profound oxygen want. For this reason, he declared the one urgent necessity in its treatment is oxygen and by the same token the one urgent requirement in its prevention is oxygen.

In a more recent study of asphyxia, Wilson, Torrey, and Johnson state that the most accurate index of the gravity of a particular case of asphyxia neonatorum is supplied by a blood analysis. These authors report oxygen contents of from 0.8 to 3.6 volumes per cent in the cord bloods of 9 infants selected as cases of asphyxia pallida. Expressed as percentage saturation of hemoglobin to conform with the figures in the foregoing paragraph, the values would approximate 35 to 17.0 per cent saturation. Again, deficiency in oxygenation of fetal blood is stressed as a constant finding in severe asphyxia.

Such reports arouse the curiosity of anyone observing a large number of newborn infants. It was felt that a series of observations upon routine deliveries at the Boston Lying in Hospital would give desirable information as to the effects of the various anesthetics usually employed there, and that something might be learned also by studying the effect of a new anesthetic agent, namely, cyclopropane. Whatever results were obtained, whether exactly similar to those of other investigators or not, would establish normal controls for further studies in this clinic. Since other investigators had placed so much stress upon the condition of the blood as regards oxygen, it was decided at first to confine data to that single biochemical factor. Undoubtedly the by hydrogen ion and carbon dioxide relationships are also of importance to an understanding of maternal and fetal respiration.

METHODS

In Eastman's studies specimens of maternal blood were obtained from an arm vein at delivery. The work of Haselhorst and Stromberger indicates that the oxygenation of venous blood in the arm is reasonably representative of the state of blood in the uterine veins. However, of much greater interest than the oxygenation of blood returning to the mother's heart is the state of her arterial blood as it arrives at the uterus. We considered it of interest to determine the arterial as well as the venous oxygen content in a representative number of mothers under each type of anesthetic studied. Since arterial blood from an extremity should not differ from that in the uterine arteries, the radial artery was used for puncture. Accordingly, an attempt was made to obtain 4 blood specimens at or immediately following the infant's delivery. These were (1 and 2) fetal arterial and venous blood from the umbilical vein and umbilical arteries, respectively, (3), maternal arterial blood from the radial artery, and (4), maternal venous blood from a vein of the same arm.

Exact synchronization of sampling was not always possible, usually because of difficulty in arterial puncture. It may be stated, however, that the umbilical cord bloods were in all cases representative of fetal conditions

before or at the moment of the infant's first breath, and that the most delayed maternal specimens were taken within a maximum of 2 minutes thereafter.

In our early work blood was taken into an oiled syringe and preserved under oil with heparin as an anti coagulant. Because of the marked solubility of cyclopropane in oil, this method was later abandoned for the ingenious procedure of Adami, in which blood is collected and stored with oxalate over mercury in a glass syringe. Oxygen content and capacity were determined by the method of Van Slyke and Neill, in the presence of ether. The technique was modified according to that of Shaw and Downing (12). In samples containing nitrous oxide or cyclopropane, the method of Orcutt and Waters was used. Except in rare instances when specimens were insufficient, determinations were made in duplicate. In many instances determinations of carbon dioxide and hydrogen ion concentration were done upon the same bloods.

The anesthetics were administered by the staff anesthetists of the hospital. The usual routine procedures were used, except that in nitrous oxide oxygen administration, the anesthetist sometimes had to deepen the anesthesia beyond the stage customary in this clinic so that relaxation sufficient for arterial puncture could be obtained. The amount of nitrous oxide in the mixture was never knowingly more than 80 per cent even on such occasions. Deeper relaxation is ordinarily secured in this clinic by the addition of ether vapor to the nitrous oxide oxygen mixture. Such anesthesia was not used in these studies because it was found impossible to analyze blood accurately for oxygen in the presence of both ether and nitrous oxide. Where ether was given alone, the ordinary open drop method was used in almost all instances. One case of ether vapor is included.

Cyclopropane was administered according to the method of Waters and Schmidt. In this technique, which is more or less standard, the system is a closed one so that the only gases involved are the nitrogen in the patient's lungs at the outset, carbon dioxide which is removed by soda lime unless maternal apnea threatens, cyclopropane, and oxygen. The

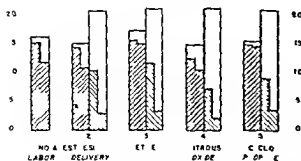


Chart 1—Maternal and fetal oxygen relationships. M A—maternal arterial M V—maternal venous F A—fetal arterial F V—fetal venous. The height of the column represents volumes per cent of oxygen capacity (plain) and of oxygen content (shaded). Second diagram from data published by Eastman (4).

mixture breathed by the patient at the time of actual delivery is calculated to contain about 15 per cent cyclopropane about 80 per cent oxygen and the rest small amounts of nitrogen and carbon dioxide. The usual period of anesthesia before delivery was from 5 to 15 minutes. In maternal specimens drawn during cyclopropane administration it was often impossible to tell the venous from the arterial specimen by a difference in color.

Practically all patients received some preliminary medication usually sodium amytal 3 to 6 grains and scopolamine 1/150 grain. This is in a way unfortunate as it introduces a variable factor in our results. However we have not been able to determine a specific effect of the type or amount of medication used upon the degree of oxygenation of fetal blood nor except in a very general way upon the promptness of respiratory onset. Moreover since it was desired to determine the biochemical status of the average baby born in this clinic the customary medication was not omitted in the mothers and infants studied.

RESULTS

In order to measure the specific effect of anesthesia upon the maternal blood determinations were first made upon the arterial and venous blood of 10 women during labor but before the administration of anesthesia for delivery. The results of these determinations are given in Table I and comprise the first columns in Chart 1. It will be seen that the level of oxygenation of arterial blood is

TABLE I—BLOOD OF PATIENTS DURING LABOR, BUT BEFORE DELIVERY

P a t i e n t	Oxygen capacity	Arterial oxygen		Venous oxygen	
		Content	Percent	Content	Percent
N 1	16.8	14.9	88.5	8	64
N 2	17.2	16	93.3	12.0	75
N 3	12.4	11.1	89.5	5.6	45.1
N 4	15	13.5	90.0	10.0	66
N 5	20.0	18.3	91.5	6.0	30.0
N 6	15.3	13.8	90.5	11.6	75.8
N 7	17.7	16.6	93.8		65.3
N 8	6.4	14.4	89	11.8	7
N 9	17.5	6	72.0	4	20.8
N 10	17.6	17.0	96.6	5.8	32.8
Average	6.8	5.4	0.5	1	7.1

slightly below the usually accepted figure of 95 per cent saturation, probably because of the actual physical work involved in labor. These figures and those to follow may be compared with data from a series of 15 normal deliveries without anesthesia in which Eastman (4) obtained the averages for maternal and fetal blood shown in the following table.

EASTMAN'S STATISTICS

Oxygen capacity—vol mes per c t	Mat r fetal
Arterial oxygen content—vol mes per c t	15.4 30.8
Venous oxygen content—vol mes per c t	14.7 5
Arterial oxygen percent	95.0 95.0
Estimated	71.5 5.8

For purposes of graphic comparison these figures have been used as the basis for the second diagram in Chart 1. It will be noted that in our series of maternal bloods before anesthesia and delivery the figure for venous blood is much the same as that for unanesthetized women at the moment of delivery.

For 21 deliveries under ether anesthesia our data are given in Table II and in the third diagram of Chart 1. The type of delivery was usually normal as is indicated in the table. With ether as with the other anesthetics studied some operative deliveries are included.

The following phenomena would appear to be associated with ether anesthesia: (1) A rise in oxygen capacity of the maternal blood; (2) a diminution in percentage saturation of maternal arterial blood. This because of the

TABLE II—DELIVERIES UNDER ETHER

Delivery*	Maternal					On et of respiration**	Fetal				
	Oxygen capacity	Arterial oxygen	Per cent	Venous oxygen	Per cent		Oxygen capacity	Arterial oxygen	Per cent	Venous oxygen	Per cent
1 ND	17.6	15.7	89.2	14.3	81.2	B	15.6	1.0	55.0	3.1	13.0
2 LF	18.4	14.7	85.3	16.4	89.6	C	21.3	0.4	43.2	3.7	17.4
3 ND	15.3	14.4	94.0	13.2	85.6	A	21.4	12.0	56.1	5.1	23.8
4 ND	17.7	16.9	95.4	15.7	88.6	B	21.0	14.2	64.3	5.0	23.2
5 ND	18.3	18.2	99.0	17.3	94.5	A	21.0	0.2	44.0	1.4	6.7
Average of 5	17.5	16.2	92.6	15.3	87.0		21.8	11.5	53.0	3.6	16.8
6 NO	15.0			13.6	84.0	A	21.3	10.2	50.2	0.4	1.7
7 ND	19.7			15.9	80.8	A	19.2	15.7	81.7	2.5	10.9
8 LF	18.0			16.2	89.9	A	20.1	14	72.8	6.1	30.1
9 LF	18.3			14.4	79.2	C	21.5	13.0	64.7	6.7	31.1
10 ND	17.4			15.2	87.4	B	21.9	12.9	60.9	3.5	16.0
11 ND	17.0			15.0	88.2	A	21.3	12.1	56.8	0.8	3.8
Average of 11	17.0			15.3	89.4		21.3	11.5	50.2	3.3	16.2
12 ND						A	21.4	3.5	16.3	1.0	4.7
13 Breech						C	20.1	11.4	56.7	1.3	7.3
14 LF						A	20.4	0.3	40.6	1.8	8.8
15 LF						A	23.1	13.5	58.4	5.4	23.4
16 ND						C	0.8	16.1	77.4	6.2	29.8
17 LF						A	19.9	15	78.9	8.8	44.2
18 ND						A	21.9	9.7	44.2	1.8	8.2
19 ND						A	20.3	12.0	58.5	2.4	11.7
20 Breech						A	22.4	11.2	50.1	1.4	6
21 ND						A	22.4	23.6	60.7	2.1	9.4
Average of 21							21.1	12.0	57.1	3.3	15.8

*N O—Normal delivery L F—low forceps

**A—Immediate B—delayed C—delayed and resuscitation required

increase in oxygen capacity just mentioned, is not necessarily accompanied by an actual decrease in volumes per cent of oxygen carried in the arterial blood. (3) A considerable increase in the oxygen saturation of the maternal venous blood, with a lessened arterio-venous difference. The average figures from the 21 infants show very little deviation from Eastman's figures for infants born without anesthesia.

Data from 20 deliveries, which included 21 infants, under nitrous oxide-oxygen anesthesia are given in Table III and Chart 1. A definite oxygen deficit in the maternal arterial blood was noted in all the 5 specimens. Oxygenation of maternal venous blood was practically the same as that in venous blood from

unanesthetized mothers, but the fetal blood showed more anoxemia than with either of the other anesthetics studied.

For cyclopropane anesthesia the figures from 19 deliveries in Table IV show the very high oxygenation not only of the arterial but also of the venous blood in the mother. In several individual instances identical values for the arterial and venous sides were obtained. Such results must be due to technical inaccuracies within the limits of error of the method but obviously they indicate a very narrow arteriovenous difference. Notwithstanding the excessive saturation of venous blood with oxygen—in fact, perhaps because of it, as will be discussed later—the fetal bloods occasionally were very poorly oxygenated.

TABLE III—DELIVERIES UNDER NITROUS OXIDE-OXYGEN

Delivery	Maternal					Onset of respiration*	Fetal				
	Oxygen capacity	Arterial oxygen	Percent	Venous oxygen	Percent		Drage capacity	Arterial oxygen	Percent	Venous oxygen	Percent
1 D	13.5	12.5	92.6	10.2	75.5	B	22.7	5.5	24.3	1.2	5.3
2 ND	13.5	13.5	88.1	10.6	69.3	A	21.7	9.0	45.6	1.8	8.3
3 ND	15.0	12.8	85.3	11.7	77.0	A	22.7	7.4	34.6	3	16.5
4 LF	13.3	1.1	91.0	9.4	70.7	A A Twin	115.3 110.1	6.4 3.7	35 5.6	3.0 0.9	5.4 4.7
5 ND	12.9	5.2	73.7	9.9	69.0	A	2	8.0	44.3	1.4	7
Average 15	5.0	12.8	86.2	9.6	70.9	Average 16	2.8	7.7	33.4	1.0	9.7
6 ND	4.5			5	72.4	A	0.7	8.5	3.5	3.4	5.8
7 ND	7.6			13.4	76.1	A	2.8	8.9	4.8		
8 ND	7.7			1.8	22.3	B	21.3	1.5	1.8	5	2.4
9 ND	11.6			2.3	86.0	A	9.6	5.0	45.4	8	4.1
10 ND	14.3			4	72.7	A	2.3	8.0	57.6	5	13
Average 1	5.7			1.5	73.5	Average 11	0.7	7.5	37.5	2.2	3
11 NE						A	26.5	15.8	50.6	2.7	14
12 ND						A	0	8.5	20.6	3	6.5
13 ND						A	2.4	7.1	4.8	2.5	11.8
14 ND						A	2.7	1.9	8.3	0.5	2.2
15 LF						A	27.5	8.0	57.2		
16 ND						A	2.1	2.3	1.8	1.5	7.1
17 ND						A	14.6	5.0	1	0.7	2.8
18 ND						A	23.9	1.4	6.1		
19 ND						A	22	11.0	52.7		
20 ND						A	1.2	4.9	23.2	4.4	26.8
Average 1							1.3	7.0	1.6	1.1	9.0

*Average 10

*Average 11

*See Table II for explanation of symbols

ated and on an average showed values below those obtained with ether anesthesia.

Before entering upon a general discussion of these results some comment is necessary regarding the wide variations in the data for any one of the three anesthetics. This is most obvious in the figures for fetal bloods in the tables representing deliveries under nitrous oxide and cyclopropane. For example in Table III, patients 1 and 3 are both representative of normal deliveries under nitrous oxide-oxygen, yet one infant is delivered with more than twice as much oxygenation of arterial blood as the other. In fact, it will be noted in the twin infants born to patient 4 in the same table that, although born from the same uterus about 4 minutes apart, the blood of the second

twin is only about half as well oxygenated as that of the first.

Anatomical and other fortuitous circumstances must play a large part in producing such variations. The element of time is probably of importance, as shown by the lower value in the blood of the second twin. Barcroft has even observed simultaneous specimens from 2 cotyledons of the same placenta in sheep to differ by as much as 50 per cent in oxygen saturation. Such facts would indicate that some scattering of results might be expected in a study such as this one, but the differences between averages for the anesthetics are so great as to indicate a specific effect upon both the mother and the child for each of them.

TABLE IV—DELIVERIES UNDER CYCLOPROPANE

Delivery**	Maternal					Onset of re-piratio ^{ns}	Fetal				
	Oxygen capacity	Arterial oxygen	Per cent	Venous oxygen	Per cent		Oxygen capacity	Arterial oxygen	Per cent	Venous oxygen	Per cent
1 ND	15.9	15.9	100.0	14.8	93.0	A	19.6	11.3	37.6	5.9	30.1
2 ND	16.1	16.1	100.0	16.1	100.0	A	21.6	8.1	35.8	2.2	9.7
3 ND	13.1	10.9	83.3	10.9	83.3	A	21.0	6.8	31.0	0.7	3.2
4 ND	17.0	17.0	100.0	17.0	100.0	C	19.8	0.7	3.5	0.6	3.0
5 ND	10.6	10.6	100.0	10.4	98.1	B	18.6	8.3	44.6	4.4	23.6
6 ND	13.7	13.3	96.7	13.6	99.4	B	20.9	14.7	70.4	3.7	17.7
7 ND	14.5	14.5	100.0	14.4	99.3	B	21.7	10.5	48.4	1.4	6.4
8 ND	16.7	16.7	100.0	16.2	97.0	A	21.1	1.9	8.6	0.9	4.0
9 ND	17.6	17.5	99.3	17.2	98.0	C	20.5	13.0	63.4	3.7	27.8
10 ND	17.8	15.2	85.3	15.1	85.0	B	19.5	13.4	68.6	9.1	46.6
11 ND	17.9	16.8	94.0	15.6	87.6	A	20.3	7.8	38.1		
12 ND	14.3	13.5	94.4	13.0	91.0	A	22.6	11.5	69.1		
Average of 12	13.6	13.0	96.5	14.7	94.3		20.8	9.1	44.9	3.5 ^a	17.2 ^a
13 Cats	18.5			15.3	82.6	A	23.3	8.1	35.1	2.8	11.5
14 LF	17.3			14.1	82.0	A	22.2	10.4	46.8	4.3	19.4
15 LF	13.3			13.0	98.0	A	20.9	13.8	66.1		
16 Cats	17.8			16.0	90.9	A	22.4	3.3	14.7	1.6	7.1
Average of 16	16.0			14.7	92.9		21.2	9.0	43.8	3.3 ^b	16.2 ^b
17 LF						C	19.8	13.0	65.6	9.5	48.0
18 LF						A	22.9	13.4	67.3	3.4	13.3
19 Cats						A	20.8	1.1	3.0	0.9	4.0
Average of 19							21.2	9.2	44.0	3.6 ^c	17.0 ^c

*Average of 10

†Average of 13

‡Average of 16

**See Table II for explanation of symbols

MATERNAL ANESTHESIA AND FETAL ANOXEMIA

Chart 1 indicates graphically that the three anesthetic agents produced, in a general way, three quite different chemical pictures in the patients studied. The use of ether appears to offer the least disturbance of normal oxygenation of fetal blood. In maternal blood it produces definite alterations not only in oxygen content but also in oxygen capacity. The result of these alterations would be to carry a normal or even more than normal supply of oxygen to the maternal side of the placenta. The arteriovenous difference is diminished in the mother, but a sufficient supply of oxygen reaches the infant in spite of the large amount returning to the heart in the mother's veins.

Changes exactly similar to those just described in the maternal blood have been

demonstrated experimentally in dogs by Shaw, Steele, and Lamb (13). These workers found, however, that with prolonged administration of ether, the arterial oxygen content fell off progressively, so that in time a state of anoxemia might result. However, for routine deliveries, ether, properly administered, appears to insure satisfactory oxygenation of maternal and fetal blood. It was hoped that in individual infants born with exceptionally good oxygenation, some particular and informative conditions would appear in the maternal blood, but examination of the table does not reveal any special maternal condition which constantly accompanies the higher fetal values.

Table III and Chart 1 show very definite results from nitrous oxide oxygen administration.

tion The effect of this agent was to reduce the amount of oxygen in maternal arterial blood to an average of only 12.8 volumes per cent of oxygen, as against the comparable figure of 16.2 volumes per cent for ether. The fetal blood suffers proportionately. Apparently the head of pressure under which oxygen arrives at the uterus under these circumstances is simply not sufficient to produce diffusion of a proper amount of oxygen through the placenta to the fetus. This fact has been emphasized by Fastman (6). That such surprisingly low levels as 1.4 and 1.9 volumes per cent of oxygen in fetal blood could be reached in occasional normal deliveries with a supposedly safe mixture of nitrous oxide and oxygen makes this confirmation of his studies worth reporting.

With cyclopropane very interesting relationships of maternal and fetal blood occur. It has frequently been noted by surgeons operating upon patients with this anesthetic that the color of the patient remains pink at all times and that the color of the venous blood is seldom as dark as with other anesthetics. Fyfe and Overholt report that in thoracic operations upon patients with lowered vital capacities the venous and arterial bloods are indistinguishable. The same fact was noted in the present study. This redness of the blood on both sides of the circulation which may be described as a decrease in the arteriovenous difference or as an arterialization of the venous blood is usually ascribed to the large amount of oxygen administered with cyclopropane.

Actually the belief that in the normal individual in the absence of pneumonia or cardiac disease the breathing of high oxygen concentrations will increase the saturation of the venous blood appreciably is not physiologically sound. Normally respiration of ordinary air produces saturation of arterial blood to 95 per cent capacity; the slight further increase possible with oxygen administration can alter the venous content only very slightly. Barach and Woodwell report determinations of oxygen content after normal subjects had breathed pure oxygen for 30 minutes. After 3 such experiments the venous blood was found to be from 69 to 83 per cent

saturated with oxygen. A normal subject in our laboratory breathed pure oxygen from a mask for 2 periods of 20 minutes each. After 1 period his venous blood was only 70 per cent saturated, after the other it reached 13 per cent. Thus the much greater oxygen saturation of venous blood observed under administration of 80 per cent oxygen and 20 per cent cyclopropane (Table IV) must be due to a specific effect of the cyclopropane itself, and not to the increased oxygen concentration in the mixture.

The specific manner in which cyclopropane produces this arterialization of venous blood must be by means of increased velocity of blood flow, probably associated with dilatation of arterioles and capillaries. This phenomenon has been shown to take place under ether, with the resulting decrease in arteriovenous difference shown in the diagram for that anesthesia in Chart 1. Our findings on the bloods of 12 mothers delivered under cyclopropane show a still smaller arteriovenous difference for this agent than for ether. It is suggested that workers in the field of capillary microscopy might verify this effect by direct observation of vasomotor conditions in patients anesthetized with this agent.

If the blood of the mother is being returned to the right heart with practically the same oxygen tension as it had in the aorta there may be a diminution in the amount of oxygen taken up by the tissues. It is of interest to note that the average oxygenation of fetal blood under maternal cyclopropane anesthesia was considerably below that under ether. It is perhaps unjustifiable to view the state of fetal hemoglobin as reflecting the condition of the maternal tissues, but the extremely low oxygenation of the fetal blood in certain cases where simultaneous maternal arterial and venous specimens have been 100 per cent saturated make this an interesting hypothesis. In any event the figures would indicate that a certain false sense of security as to the condition of the infant, might arise from considerations based solely upon the appearance of the maternal blood.

Judged then from the standpoint of proper oxygenation of fetal blood during delivery, these observations indicate cyclopropane anes-

thetia, as administered in this clinic, to be more advantageous than nitrous oxide oxygen, but considerably less satisfactory than ether

FETAL ANOXEMIA AND ASPHYXIA NEONATORUM

At the inception of this study a definite correlation was anticipated between promptness of respiration and degree of anoxemia in individual infants. The two series of severely asphyxiated infants reported by Eastman (5) and by Wilson, Torrey and Johnson, had regularly shown an extremely low oxygenation of blood at delivery. From their figures it was inferred that asphyxia was almost to be expected in any infant whose arterial blood carried less than about 3 volumes per cent of oxygen.

In order to correlate fetal anoxemia and asphyxia neonatorum, the 61 infants whose blood was studied were arbitrarily graded as to the onset of respiration. The symbol "A" was used for infants breathing and crying lustily and immediately. There were 45 such infants. Very light and feeble respiration, or a delay in onset not sufficient to warrant attempts at resuscitation, was designated as "B." There were 9 infants in this group. The 7 infants remaining required some degree of resuscitation of a simple type and not prolonged beyond a few minutes by the obstetrician. This group was designated as "C." This impressionistic classification was found to be more informative than actual measurements of time elapsed before the first breath. However, it soon became apparent that these varying degrees of apnea were not constantly accompanied by the expected alterations in oxygenation of the infant's blood. While no babies in the series were critically asphyxiated, the variations in the onset of respiration were significant enough to be graded easily, yet this grading was not borne out by significant differences in the laboratory findings. This will be seen in Tables II, III, and IV, and more especially in Table V, in which the data from fetal bloods are grouped according to presence or absence of apnea at birth. Only in the 2 "slow" babies delivered under nitrous oxide-oxygen is there a definite correlation between anoxemia and apnea.

Whatever explanation may be offered for this lack of correlation must explain 2 types of results: first, those infants who were active and breathed at once, or Class A, but whose cord blood was definitely anoxic, and second, those infants with some degree of apnea, or Classes B and C, whose blood showed average or better than average saturation with oxygen. Two explanations are possible. The first is that marked anoxemia at delivery bears no etiological relationship to asphyxia neonatorum. The studies of Eastman, and of Wilson and his colleagues, on definitely asphyxiated babies are too convincing to make this tenable. The second explanation is that anoxemia represents but one of several factors which, carried to a certain extent, and perhaps acting in summation, may interfere with the normal onset of respiration. On the basis of the results reported in the present communication, this latter explanation would seem to be the correct one. An interesting corollary of this hypothesis is the very apparent fact that the fetus can occasionally stand remarkably low levels of oxygenation, although probably for very brief periods, and still be capable of normal respiration. One wonders if, were it possible to analyze blood from the apneic baby a few minutes after the cord is clamped but before breathing begins, still greater degrees of anoxemia might not be demonstrated.

The other factors which also act to produce apnea in infants with satisfactory oxygenation of blood at birth, would of course include the variable elements of time and of direct physical trauma in delivery, the pre-anesthetic medication, the direct narcotic effect of obstetrical anesthesia upon the central nervous system of the fetus, and probably such other biochemical factors as the hydrogen ion content of the fetal blood and its carbon dioxide tension. The first of these we do not attempt to discuss beyond listing the type of each delivery in the tables. A tabulation of the amount of pre-anesthetic medication used in the deliveries studied is too cumbersome to be presented, but showed that mothers of the babies graded B and C received on the average slightly more medication than did the mothers of those babies breathing actively and at once.

TABLE V —RELATION OF APNEA TO OXYGENATION OF FETAL BLOOD

O s t fre p u a t i n	Ether	V o l u m e p e r c e n t o x y g e n i n b l o o d	
		A r t e r i a l	V e n o s
14 A*		13.6	2.9
3 B		13.3	3.9
4 C†		12.4	4.5
Nitrous oxide			
19 A		7.3	2.3
2 B		4.0	0.85
Cyclopropane			
12 A		8.4	2.5
4 B		11.7	4.6
3 C		8.9	5.3

*A—Immediately

**B—Slightly delayed

†C—Delayed

TABLE VI —VOLUMES PER CENT OF ANESTHETIC IN MATERNAL AND FETAL BLOODS

A n e s t h e t i c	M a t e r n a l		F e t a l	
	A r t e r i a l	V e n o s	A r t e r i a l	V e n o s
Nitrous oxide—average	28.0	21.7	13.5	9.8
Cyclopropane—average	7.5	6.7	6.0	5.1

As to the direct effect of the anesthetic administered to the mother and reaching the infant's central nervous system by way of the placenta and fetal circulation a small amount of suggestive data can be offered from this study. While it was not possible to determine the relative amounts of ether in maternal and fetal blood at birth, the method of Orcutt and Waters offers an apparently accurate measurement of the volumes per cent of nitrous oxide or of cyclopropane present in any specimen of blood to be analyzed. Table VI shows how much of the anesthetic gas was actually present in the maternal and fetal blood at the time the cord was clamped in deliveries under those anesthetics. It is notable that with nitrous oxide-oxygen, in which the number of apneic infants was very small, the infant at birth had less than half as much anesthetic in his blood as was present in the maternal blood. In cyclopropane deliveries in which there were more apneic infants the concentration of the anesthetic was almost as high in the fetal as in the maternal circulation. Just how important the narcosis produced by anesthesia of the infant is, as a cause of critical asphyxia, remains to be determined.

These results would indicate that it exerts a specific effect which cannot be neglected. Finally, it is to be hoped that the place of disturbed acid base relationship and of carbon dioxide tension may be evaluated by further study.

SUMMARY AND CONCLUSIONS

Determinations were made of the oxygen content of arterial and venous blood from women during labor. Similar determinations were made upon the arterial and venous bloods of 3 groups of mothers and their infants at the moment of birth. These 3 groups represented routine deliveries under ether, under nitrous oxide oxygen, and under cyclopropane anesthesia. In the second and third of these groups, the amounts of nitrous oxide and of cyclopropane were also quantitatively determined in the maternal and fetal bloods. An attempt was made to correlate the degree of oxygenation of maternal and fetal blood with the type of anesthetic used, and to discover the relationship between fetal hypoxemia and the presence or absence of apnea in the newborn infant. The following observations seem significant:

1. Oxygenation of maternal blood during labor but before delivery and anesthesia was comparable to that observed by other authors for maternal blood at delivery without anesthesia. The arterial blood during labor showed a slight hypoxemia.

2. Specimens of fetal blood at the moment of birth showed wide variations in oxygen content, presumably because of anatomical and other uncontrollable circumstances. As a rule, the fetal blood at birth even on the arterial side, was considerably deficient in oxygen.

3. In general ether anesthesia produced a definite elevation of the maternal oxygen capacity, and of the oxygenation of maternal venous blood. Under this anesthesia the fetal oxygenation appeared to be satisfactory.

4. Nitrous oxide, administered with at least 20 per cent oxygen, produced a definite maternal and fetal hypoxemia.

5. Under cyclopropane, the maternal blood showed a pronounced elevation of oxygenation in both the arterial and venous specimens.

The cause of this phenomenon is discussed. It is probably not due to the high concentration of oxygen administered with cyclopropane. The blood of infants delivered under this agent was somewhat better oxygenated than those born under oxide oxygen. It contained less oxygen than the blood of infants delivered under ether, or that reported in the literature for those delivered without maternal anesthesia.

6 Pronounced anoxemia in the fetal blood at birth was not constantly accompanied by apnea of the newly born infant, except in babies delivered under nitrous oxide oxygen. Fetal anoxemia is probably one of several factors which may operate to produce apnea. A surprising degree of fetal anoxemia may be associated with a normal onset of respiration.

7 Cyclopropane was present in the fetal blood in almost as high concentration as in the maternal blood. However, only about half as much nitrous oxide was found in the fetal as in the maternal blood.

8 Judged by biochemical data, cyclopropane as an obstetrical anesthetic would appear to be perhaps less safe for the infant than the clinical appearance of the mother would indicate.

REFERENCES

- 1 ADEBANT, J. A method for collecting blood for gas analysis. *J Lab & Clin Med* 1938 23 1094-1096.
- 2 BARACH, A. L. and WOODWELL, M. Studies in oxygen therapy. *Arch Int Med* 1921 28 367-393.
- 3 BARCROFT, J. Fetal circulation and respiration. *Physiol Rev*, 1936 16 103-128.
- 4 EASTMAN, N. J. Fetal blood studies. 1 The oxygen relationships of umbilical cord blood at birth. *Bull Johns Hopkins Hosp*, 1930 47 221-230.
- 5 Idem. Fetal blood studies. 3 The chemical nature of asphyxia neonatorum. *Bull Johns Hopkins Hosp* 1932 50 39-50.
- 6 Idem. Fetal blood studies. 5 The rôle of anesthesia in the production of asphyxia neonatorum. *Am J Obst & Gynec* 1936 31 563-572.
- 7 EASTMAN, N. J., GEILING, E. M. K. and DELAWDER, A. M. Fetal blood studies. 4 The oxygen and carbon dioxide dissociation curves of fetal blood. *Bull Johns Hopkins Hosp* 1933 53 246-254.
- 8 EASTMAN, N. J. and McLANE, C. M. Fetal blood studies. 2 The lactic acid content of umbilical cord blood under various conditions. *Bull Johns Hopkins Hosp* 1931 48 261-268.
- 9 EVERSOLE, U. H. and OVERHOLT, R. H. Anesthesia in thoracic surgery. *J Thoracic Surg* 1936 5 510.
- 10 HASELHORST, G. and STROMBERGER, K. Ueber den Gasgehalt des Nabelschnurblutes vor und nach der Geburt des Kindes. *Ztschr f Geburtsh u Gynaek* 1930 98 49-78.
- 11 ORCUTT, F. S. and WATERS, R. M. A method for the determination of cyclopropane, ethylene and nitrous oxide in blood. *J Biol Chem* 1937 117 509-515.
- 12 SHAW, J. L. and DOWNING, V. The determination of oxygen in blood in the presence of ether by a modification of the Van Slyke-Neill technique. *J Biol Chem*, 1935 109 405-417.
- 13 SHAW, J. L., STEELE, B. F. and LAMB, C. A. Effect of anesthesia on the blood oxygen. *Arch Surg* 1937 35 1-10.
- 14 VAN SLYKE, D. D. and NEILL, J. M. The determination of gases in blood. *J Biol Chem*, 1924 61 523-573.
- 15 WATERS, R. M. and SCHMIDT, E. R. Cyclopropane anesthesia. *J Am M Ass* 1934 103 915-983.
- 16 WILSON, R. A., TORREY, M. A. and JOHNSON, K. S. Initiation of respiration in asphyxia neonatorum. *Surg Gynec & Obst* 1937, 65 601-622.

MERCURIC CHLORIDE, POTASSIUM MERCURIC IODIDE, AND HARRINGTON'S SOLUTION IN SKIN DISINFECTION

Behavior and Uses

PHILIP B. PRICE, M.D. Baltimore, Maryland

BRIEF reference was made in a recent communication (27) to the remarkable effects produced when mercuric chloride, potassium mercuric iodide and Harrington's solutions are applied to healthy skin. These phenomena were first observed when the germicides in question were subjected to a new quantitative test of skin disinfectant value (28). The purpose of the present paper is to report results of that work more fully and on the basis of those findings and our interpretations of them to indicate what we consider to be the rational use of these widely employed disinfectants and the place they should occupy in surgical technique.

The three germicides are combined in a single report because they are related chemically and also because on skin they exhibit marked similarities in behavior.

Few drugs are more familiar to surgeons or have been more widely employed in surgery than these time honored mercurials. Yet none has been less perfectly understood.

Bichloride of mercury was at the beginning of our modern surgical era given first place among antiseptics by Koch and other influential investigators (18, 24, 3, 34). Despite well known disadvantages like irritation of tissues, precipitation of proteins and corrosion of metals, the disinfectant soon became universally popular. Geppert (8) discovered, however, by precipitation of the mercury as an inert sulphide that sublimated bacteria may still be alive, though unable to grow in culture media, and that the action of the mercuric salt is bacteriostatic more than bactericidal. Halsted (10), Welch and Kelly, applying this discovery clinically, demonstrated that although hands washed in bichloride

may to ordinary tests appear nearly or quite sterile, subsequent use of ammonium sulphide shows them to be laden still with living bacteria—a phenomenon which has never been satisfactorily explained. Kodewald proved that certain bacteria incapable after sublimation of growth in culture media may yet be pathogenic when injected into the body. But these are only high lights. The disinfectant action of mercuric chloride has been the subject of literally countless investigations during the last 60 years. The trend however has been away from a study of the agent as a practical germicide to laboratory researches into the nature of disinfection (3, 14, 17, 21, 31, 33).

Potassium mercuric iodide generally given a disinfectant rating approximately equal to that of bichloride, is believed to possess in addition certain important advantages—non irritation of tissues, non precipitation of proteins and non corrosion of metals. It has not been studied as intensively, however, or as critically as has bichloride. Most investigators of bichloride have erred in failing to employ an antidote in their tests. Accepted uncritically, potassium mercuric iodide has become increasingly popular as a disinfectant for hands and for the field of operation.

Harrington's solution was introduced in 1903. It is perhaps the best known of many combinations of alcohol and mercuric chloride that have been recommended. It is conceded to be strongly germicidal but an irritating quality has limited its practical usefulness.

EXPERIMENTAL INVESTIGATION

A recently introduced method (28) has been used by means of which the effect of any

From the Department of Surgery, Chee-soo University, China, and the Department of Pathology and Bacteriology, Johns Hopkins University School of Medicine.

The following table of mercuric compounds (11a) is given in the original paper (28) as a basis for comparison. It is not intended to be used loosely in the comparison of the relative activity of these compounds.

cutaneous germicide can be measured quantitatively in terms of reduction of the existing bacterial flora. The method consists essentially in (a) scrubbing the hands and arms in a perfectly uniform manner and for equal lengths of time in a series of basins of sterile water, (b) application of the germicide, followed (if desired) by its antidote, and (c) scrubbing as before in a second series of basins. Cumulative totals of bacterial counts of the washings (steps a and c) plotted against time produce curves from which the size of the bacterial flora of the entire cutaneous surface washed can be determined numerically. Comparison of the two curves, which are plotted independently, shows what effect the chemical has had upon the existing flora. Details of a typical experiment are given in Table I.

The solutions tested were 1:1000 mercuric chloride, 1:500 potassium mercuric chloride, and Harrington's solution made up according to the original formula. These solutions were in every case freshly prepared from chemically pure salts and distilled water, were placed in sterile basins, and were used at 25 degrees C without friction. Five or 10 per cent pure (light) ammonium sulphide solution proved a satisfactory antidote, controls showing that these strengths have of themselves no appreciable effect upon the cutaneous bacterial flora.

To recount all of our tests in detail would be tedious, instead results of groups of experiments will be reported, with illustrative figures and brief comments. The figures will repay careful study, since they show graphically what actually happened to the bacterial flora of the skin during these experiments, and indicate what occurs whenever a surgeon washes his hands in one of these mercurials.

1. Effects of applying mercuric solutions to skin. The actions of the three germicides are quite similar. Used for one minute or longer, the invariable result is that very few bacteria, either normal or sublimated, can be found in the second series of basins, i.e., a cutaneous surface is produced which yields few if any organisms when washed and brushed. Figure 1 shows how the total flora of the hands and arms, which was being reduced at a regularly logarithmic rate by scrubbing (in the first

TABLE I.—EFFECTS OF 1:500 POTASSIUM MERCURIC IODIDE SOLUTION UPON THE BACTERIAL FLORA OF HANDS AND ARMS

Basin	Scrubbing time minutes	Total bacterial count for basin organisms	Cumulative totals washed off organisms	Actual totals or size of flora left organisms
				7 663 600 (a)
1	2	2 804 780	5 073 600	4 768 910
2	2	784 470	3 108 910	3 984 490
3	2	460 500	2 734 400	3 574 900
4	2	786 080	1 774 000	2 738 010
5	2	525 760	988 010	2 172 250
6	2	462 250	462 250	1 750 000 (b)

At this point hands and arms washed in 1:500 K. Igl. solution for 60 seconds. Temperature 24.5 C. Excess of disinfectant quickly rinsed off and scrubbing resumed.

				1 750 000 (c)
7	2	3 000	24 730	2 790 000 (d)
8	2	10 900	21 730	2 860 000 (e)
9	2	6 450	10 830	2 950 000 (f)
10	2	4 350	4 380	2 046 000 (g)

Hands and arms washed in 5 per cent (NH₄)₂S solution for 1 minute. Excess rinsed off and scrubbing resumed in a third series of basins.

				2 046 000 (h)
11	2	216 250	1 246 000	1 820 750
12	2	337 550	910 750	1 492 200
13	2	386 400	597 200	1 105 800
14	2	205 800	205 800	900 000 (i)

(a) Total number of bacteria on the hands and arms at the beginning of the experiment. (b) after 1 minute of scrubbing. (c) after use of the disinfectant. (g) after the second period of scrubbing (7 minutes). (h) after using the antidote. (i) after the third period of scrubbing (8 minutes). (b) and (i) are arrived at by mathematical projection of the curves to zero. (c) (d) (e) (f) and (g) are estimated from the known curve value and the cumulative totals of bacteria washed off in the second group of basins.

Control cultures made of water glassware media air contamination etc. Special tests showed that washings in basins 7 and 11 were not bacteriostatic. Previous tests had shown that neither potassium mercuric iodide nor ammonium sulphide solutions kill appreciable numbers of bacteria when applied to skin.

Actual totals of this experiment plotted against time are shown in Figure 3.

series of basins), became fixed, as it were, at that level by the mercurial so that subsequent scrubbing failed to reduce it further. When, however, as in Figure 2, the mercurial is followed by an antidote, results are quite different, for the second period of scrubbing in that case reduces the flora at the same rate as the first. These characteristic effects—fixation of the cutaneous bacteria and their release—are illustrated even more clearly in Figure 3. This is precisely the phenomenon described so

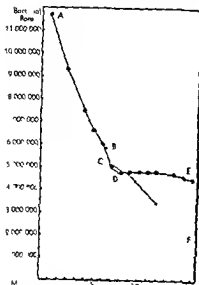


Fig 1 Results of washing in 1:1000 mercuric chloride without a neutralizing agent. *AB* Effect of scrubbing for 6 minutes. *BC* increased effect due to scrubbing for 1 minute without soap. *CD* relatively slight reduction of total flora caused by washing for 1 minute in the mercurial at 25 degrees C. *DE* result of subsequent period of scrubbing.

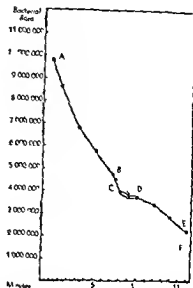


Fig 2 Results obtained when the mercurial is followed immediately by its antidote. *ABC* Reduction of flora during the first period of scrubbing. *BCD* Reduction of flora during the last period of scrubbing. *DE* Reduction of flora without soap. *CD* hands and arms washed in 1:1000 mercuric chloride for 1 minute followed by ammonium sulphide solution. *DE* indicates the second period of scrubbing.

years ago by Halsted, Welch and Kelly, but which has never been satisfactorily explained.

Other experiments of a similar nature have brought out additional facts. If hands which have been washed in a mercurial and in consequence present a germ free surface are scrubbed long and vigorously enough, bacteria begin to appear in the washings until at length (after 20 minutes of scrubbing in one of our experiments) bacteria may come away at the usual rate. A biniodide surface is found to be more resistant to such friction than one produced by bichloride. Furthermore, the number of cutaneous organisms killed by washing the hands and arms in potassium mercuric iodide or Harrington's solution is very small—too small indeed, to be detected by our quantitative test. Mercuric chloride has a slight bactericidal effect reducing the total flora by about 5 per cent per minute, which is about half the rate of degeneration by scrubbing. Even this slight action diminishes after a few minutes' exposure to the chemical, and eventually ceases altogether, so that further soaking in the disinfectant is without bactericidal effect.

To explain these results we postulate a combination of some sort between the epidermis and mercuric salt to produce in effect if not actually, a thin, transparent film which covers the cutaneous surface and its minute crevices and depressions wherein lie most of the bacteria (28). This interaction takes place so rapidly, especially in the case of potassium mercuric iodide and Harrington's solution that the 'film' prevents the germicides from coming into effective contact with the underlying bacteria. In other words, on skin the germicidal activity of all three of these agents is self limiting to a remarkable degree. These 'films' can be abraded by prolonged brushing in consequence of which some of the underlying organisms are released. Ammonium sulphide on the other hand acts upon the 'film' chemically, so changing its character that it no longer hinders removal of bacteria from skin at the usual rate.

2. *The fate of bacteria beneath the 'film'*
The experiments here described indicate clearly that skin organisms held momentarily under these 'films' are alive and upon escape are fully capable of growth in culture media.

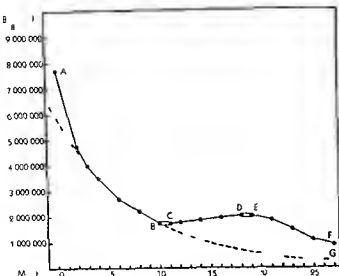


Fig 3 Results obtained when the mercurial is followed by a delayed use of the antidote *AB*. Results of the first period of scrubbing *BC* 1:500 potassium mercuric iodide washed in for 1 minute followed by a second period of scrubbing *CD* 5 per cent ammonium sulphide applied *DE* and scrubbing was resumed in a third series of basins

A second group of experiments was designed to study the effect of longer periods of imprisonment. In these tests the flora of the hands and arms were first measured, in some cases qualitatively as well as quantitatively, then the mercurial was applied, finally after selected periods of time the "film" was broken up by ammonium sulphide and friction, and the flora measured anew. The following effects were observed.

Beneath these "films" bacteria of the skin not only live uninjured, but proceed at once to multiply at an abnormally rapid rate, their number doubling every 55 to 60 minutes. Generation time on skin ordinarily is several hours (28). Figure 4 shows that the increased flora comes away with scrubbing at the same rate as the original flora. Furthermore, our qualitative studies provided evidence that the different sorts of bacteria which make up the cutaneous flora all participate in this increase, and apparently at much the same rate.

The effect of "films" upon underlying bacteria over much longer periods of time was noted also. As might be expected, unlimited increase in numbers of organisms is counteracted by gradual break up of the "films" by friction against clothing and other objects, with consequent loss of surplus bacteria from the skin. Figure 5 shows conditions found 3

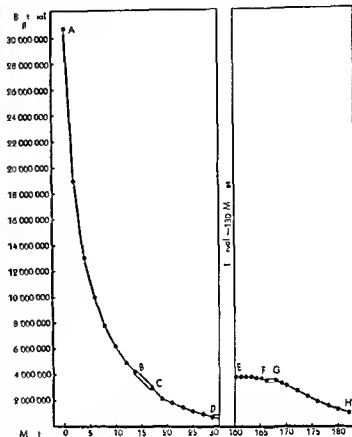


Fig 4 Bacteriological effects of wearing the "film" for a longer period of time. The very large initial flora in this instance was the result of having washed in a mercurial and its antidote a few days previously. Prolonged scrubbing, *AB* and *CD* and 3 minutes application of 60 per cent by weight (approximately 70 per cent by volume) alcohol *BC* reduced the bacterial count to 705,000. *D* Hands and arms washed in 1:500 potassium mercuric iodide solution. During 130 minute interval skin not protected from clothing or other unsterile objects in laboratory. *EF* scrubbing resumed. *FG* ammonium sulphide applied. *GH* final period of scrubbing.

days after the hands and arms had been washed in bichloride without an antidote. A rather large flora was encountered, and enough of the "film" remained to interfere considerably with degeneration by scrubbing.

Strangely enough, when hands have been washed in one of these mercurials, followed immediately by ammonium sulphide, their bacterial counts may, in a few days, reach 15 to 30 million or more. These large bacterial populations are reduced by scrubbing at the same rate as the ordinary flora of skin.

It has been shown (28) that cutaneous bacteria are ordinarily of two sorts—"resident" and "transient" (contaminating) organisms. The latter are much more easily killed or removed than the former. Since well scrubbed

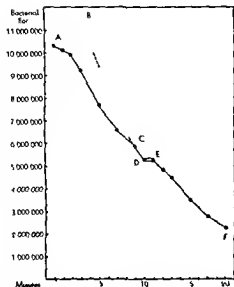


Fig. 5. The bacterial flora 3 days after the hands and arms had been washed in 1:1000 bichloride solution without a neutralizing agent. A, Initial flora; B, effect of brushing without soap; C, usual rate of degermation by scrubbing; D, E, 30 per cent ammonium sulphide applied.

hands are virtually free from contaminating germs all the foregoing observations are concerned with the resident flora. It is of importance however to know what effect these disinfectants have upon contaminated hands. Consequently experiments were performed in which known numbers of identifiable test bacteria not normally found on skin, were rubbed on the hands which then were washed in bichloride or biniodide solution. After various intervals of time an antidote was applied and the skin was tested quantitatively and qualitatively for surviving organisms. These experiments were not wholly successful. Technical difficulties were encountered in adapting differential culture media to quantitative studies. And perhaps certain variables like the thoroughness with which the test bacteria were rubbed on the skin were not controlled carefully enough. But at least this significant result may be reported. In none of these tests did the disinfectant kill all the contaminating organisms whereas under the 'film' the remainder multiplied until in some instances, they at length exceeded the original number.

3. *Impermeability of the 'film'* It has been noted already that the outer surfaces of

these 'films' remain sterile, or very nearly so even though the skin beneath may harbor large numbers of "resident" and contaminating bacteria. This strongly suggests that the film like structure does not permit passage of bacteria. Corroboration was provided by experiments in which test organisms were placed on the outside of the 'film'. After given intervals of time the 'film' was carefully washed off and treated with ammonium sulphide. None of the test organisms could be found on the skin beneath.

Permeability of the "film" to alcohol was tested also. It has been shown elsewhere (27, 28) that a solution of alcohol exactly 70 per cent by weight is a very effective skin disinfectant. When skin is washed without friction for 2 minutes in this solution its bacterial flora is reduced by about 76 per cent. We found however, that if the hands are first bathed for a minute in 1:500 potassium mercuric iodide solution, 70 per cent alcohol is capable of reducing the flora by only 13 per cent, doubtless because the "film" prevents the alcohol from making effective contact with the bacteria of the skin. Harrington's solution contains 60 per cent (by volume) alcohol and 2 per cent hydrochloric acid both of which are somewhat germicidal on skin as well as *in vitro*. But Harrington's solution kills a negligible number of organisms when applied to skin, in all probability because the mercuric salt acts promptly to form a film which protects the underlying bacteria from the other chemical agents.

4. *Chemical nature of the 'film'* It is commonly stated that mercuric chloride reacts with the proteins of skin to form mercuric albuminate, and that addition of ammonium sulphide precipitates the mercury in the form of mercuric sulphide as proved by discoloration of the skin. That however is over simplification of a very complex set of changes.

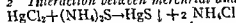
Even in the case of soluble albumins the problem is complicated as the following simple test tube experiments indicate.

1. *Interaction between mercuric and soluble albumin*

$HgCl_2$ + ascitic fluid → a white precipitate. This precipitate probably a mercuric proteinate of some sort settles in light flocculent form leaving a clear supernatant fluid which seems to contain both

mercury and protein, however since it turns amber colored upon addition of sulphide (see interaction 3) The precipitate dissolves in an excess of acetic fluid

2 Interaction between mercurial and sulphide



This is a heavy black granular precipitate which settles rapidly, especially after several washings

3 and 4 Interactions between the "mercuric protoleate" and sulphide

3 White precipitate (from 1) + $(\text{NH}_4)_2\text{S}$ —a brown precipitate

This is a dirty brownish flocculent precipitate which settles slowly at first but more rapidly when washed. It does not look like the mercuric sulphide (HgS) of 2. It dissolves readily in an excess of sulphide imparting an amber color to the solution. The presence of a relatively small amount of acetic fluid suffices to prevent formation of the black mercuric sulphide (HgS) in 2

4 White precipitate (from 1) + a large excess of $(\text{NH}_4)_2\text{S}$ —a blackish precipitate

All four of these interactions are practically instantaneous

Solubilities of the precipitates are as follows

Solvent	1	2	3	4
Water	o	o	o	o
Alcohol 70 per cent (by weight)	o	o	o	o
Sodium chloride, saturated solution	o	o	o	o
Hydrochloric acid N/10	+	o	+	o
Acetic acid 10 per cent	o	o	o	o
Sodium hydroxide N/10	o	o	o	o
Excess of ammonium sulphide	o	o	+	o
Potassium iodide solution	+	o	+	o

Obviously the result of interaction 3 is not simply to precipitate mercuric sulphide. There we are dealing with complex actions between organic and inorganic substances

What happens on skin, especially when a great excess of ammonium sulphide is not employed, is difficult to determine. Here the problem is complicated by the fact that we are concerned, not with soluble albumins, but with albuminoids which are characterized by insolubility. So also, doubtless, are their compounds. The discoloration of skin produced by mercuric chloride cannot be removed with acids or potassium iodide

As for potassium mercuric iodide, it is generally held that this reagent does not precipitate albumin nor react with the skin. Against such a view it may be pointed out that the presence in solution of egg or serum albumin diminishes the bactericidal activity of potassium mercuric iodide, even though no visible precipitation takes place that the salt does "combine" with skin, as we have shown and that this combination is in turn acted upon by ammonium sulphide, and that although

hands washed in potassium mercuric iodide solution will not be stained by 5 or 10 per cent ammonium sulphide, they will be turned black by 30 per cent solution

The following simple test is also significant. If to an aqueous solution of potassium mercuric iodide a little ammonium sulphide is added, a clear amber colored solution results. If more ammonium sulphide is added, a black precipitate appears which is insoluble in all ordinary reagents. This action is non reversible. In an alcoholic, and especially an acetone, solution of potassium mercuric iodide the precipitate appears sooner, but the presence of serum albumin in the solution delays its appearance.

It appears, therefore, that potassium mercuric iodide "reacts" with, or is absorbed by, albumin, but that the compound or complex remains in solution or suspension, that the mercuric salt also "reacts" with the albuminoids of the skin to form a colorless complex that is not acted upon by water, that small amounts of ammonium sulphide act upon these complexes, changing them but not producing any visible precipitate, and that a great excess of ammonium sulphide acting upon either complex produces a black precipitate, which is at least very similar to mercuric sulphide.

The reason, probably, why use of potassium mercuric iodide (without an antidote) does not turn nails and skin dark is that the amount of mercuric mercury free to combine with the sulphur compounds of skin is infinitesimally small.

EVALUATION OF STUDY

The production of an invisible, sterile, impermeable "film" whenever non greasy skin is washed in one of these mercurials—a "film" which overlies and protects the cutaneous bacteria, and may be destroyed with difficulty by friction but easily by means of an alkaline sulphide—is, we believe, the true explanation of the phenomenon which so puzzled Halsted and Welch. It is perhaps the chief reason why certain surgeons, in days before rubber gloves came into use, were able at times to

²For further discussion of reactions between mercuric salts and albuminoids see: Mellor J. W. A Comprehensive Treatise on Inorganic and Theoretical Chemistry. London and New York: Longmans Green & Co. 1923. 11, 825 & d 944.

operate bare handed with almost perfect asepsis. And it helps to explain why various investigators, testing the skin disinfectant value of these mercurials using different technique should have obtained such divergent results.

The following is an attempt to indicate the rational and most effective use of these mercurials, and the place which they should occupy in surgical technique. The recommendations are founded upon the experimental studies outlined in this paper but they have also been tested practically over a period of 3 years in the University Hospital (Tsinan China) with clinical results which strengthen our belief in their truth and value.

In pre-operative disinfection of hands bichloride and biniodide of mercury should have a definite though limited place. When for any reason the ungloved hand must be used in surgery or obstetrics one of these agents may be employed to great advantage. A solution of 1,500 potassium mercuric iodide is the preferable one. Short nails a thorough preliminary scrub followed by a one minute wash in the mercurial and the operator will have on his hands the equivalent of an invisible extremely thin but strong sterile glove. That procedure will also increase the margin of safety for the occasional operator even though he wears rubber gloves. But neither bichloride nor 'biniodide' is recommended for constant use. Hands which have been washed recently in any of these mercurials may be expected to have abnormally large bacterial counts which cannot be reduced easily or with any certainty. If it is desired to use both alcohol and a mercurial the former to be effective should precede not follow the latter.

In preparation of the field of operation also potassium mercuric iodide should have a well understood place. Applied to non greasy skin this agent produces a surface which is practically germ free and probably will remain so throughout the operation provided it is not abraded unduly. But any incision must of necessity pass through the film and the germ laden skin beneath inevitably inviting infection of the wound. If however, the site of incision is first adequately degermed—

methods of accomplishing this have been described (27, 29)—a mercurial may then be used effectively to disinfect the surrounding area of skin, in the sense of walling-off all the nearby potentially infectious bacteria. Such a procedure is particularly useful in treating large irregular surfaces, such as the hand or foot which are difficult to "paint" with a germicide but are easily soaked for a minute or more in a basin of potassium mercuric iodide solution.

Use of bichloride or 'biniodide' solutions to disinfect hands contaminated with pathogenic micro-organisms is contra indicated. It cannot be expected that all the infectious bacteria will be killed thereby. The pathogenic germs that remain alive may multiply some to escape as the 'film' is abraded others to be incorporated gradually into the 'resident flora' of the skin. It is conceivable that hands may thus become both acute and chronic healthy carriers of infection.

Since Harrington's solution is shown to possess no advantages over bichloride and 'biniodide' solutions, but has the disadvantage of being irritating to skin its use might well be abandoned altogether.

SUMMARY

1. The skin disinfectant properties of mercuric chloride, potassium mercuric iodide, and Harrington's solutions have been investigated, by means of a recent experimental method which tests quantitatively the degerming action of disinfectants upon skin.

2. The three solutions are quite similar in behavior when applied to skin. Strictly speaking they are disinfectants rather than germicides the reason being that they reduce the bacterial flora of normal skin very slightly or not at all, yet all three are capable of producing a sterile or nearly sterile skin surface. This is due to reaction of the mercurial and epidermis to form a film like structure which overlies the bacteria.

3. This invisible 'film' is impervious to bacteria, is only slightly permeable to alcohol and is remarkably resistant to friction.

4. Beneath the film cutaneous bacteria not only live unharmed but multiply at an abnormally rapid rate, their number doubling every 30 to 60 minutes.

5 The "film" may be abraded by prolonged friction, and the underlying bacteria then slowly liberated. Ammonium sulphide, on the other hand, acts upon the "film" promptly, destroying it (at least in its original form), so that subsequent removal of skin organisms is not interfered with.

6 The complex chemical reactions involved are discussed.

7 On the basis of our experimental results, the following recommendations are made as to the rational use of these disinfectants in surgery.

8 Harrington's solution might well be discarded altogether.

9 Bichloride and "biniodide" of mercury have a definite though limited place in pre-operative preparation of hands. They should not be employed routinely or frequently, but in lieu of rubber gloves and for the occasional operator, their use seems clearly indicated.

10 They have a value also in preparation of the field of operation, provided the site of incision is first adequately degermed.

11 Neither solution should be used to disinfect hands contaminated with pathogenic bacteria.

These recommendations have been tested clinically with satisfactory results.

It is a pleasure to express my indebtedness to Dr. J. Ward Brown for generously granting me facilities of his laboratories and for helpful suggestions in preparation of material for publication. I am under obligations also to Dr. Leslie Helleman for constructive criticism of the clinical aspects of this report.

BIBLIOGRAPHY

- 1 BREWER J H The antibacterial effects of the organic mercurial compounds etc. Dissertation submitted to Johns Hopkins University, 1938 (As yet unpublished)
- 2 BOLLOCH W The viability of bacteria in antiseptic solutions. *Zentralbl f Bakteriologie* 1927 106 21
- 3 CHICK H An investigation of the laws of disinfection. *J Hyg* Cambridge 1908 8 92
- 4 Idem The process of disinfection by chemical agents and hot water. *J Hyg N Y* 1910 10 237
- 5 CHICK H and MARRIV C J The principles involved in the standardization of disinfectants etc. *J Hyg*, Cambridge 1908 8 634
- 6 CLOCK R O The fallacy of chemical sterilization of catgut sutures. *Surg Gynec & Obst* 1933 56 149
- 7 GEGENBAUER V Studien ueber die Desinfektionswirkung des Sublimats. *Arch f Hyg* 1924, 90 23
- 8 GEPPERT J Zur Lehre von dem Antiseptics. *Berlin klin Wchnschr* 1889 26 789 819
- 9 Idem Zur Desinfektionsfrage. *Deutsche med Wchnschr* 1891, 17 797, 815 855
- 10 HALSTED W S The treatment of wounds, etc. *Johns Hopkins Hosp Rep* 1890-91 2 285
- 11 Idem Bichloride irrigations. *Johns Hopkins Hosp Bull*, 1895, 6 164
- 12 HAMPTON B The influence of soaps on the germicidal properties of certain mercurial compounds. *Am J Hyg* 1931, 13 623
- 13 HARRINGTON C Some studies in asepsis. *Ann Surg*, 1904, 40 475
- 14 KALENBERG Electrolytic dissociation viewed in light of recent facts. *J Phys Chem*, 1901 5 340
- 15 KELLY H A Hand disinfection. *Am J Obst*, 1891, 24 1414
- 16 KOCH R Mittheilungen aus dem kaiserlichen Gesundheitsamte 1881 vol 1
- 17 KROENIG B, and PAUL, TH Die chemischen Grundlagen der Lehre von der Giftwirkung und Desinfection. *Ztschr f Hyg u Infektionskrankh*, 1897 25 1
- 18 LAPLAGE, E Saure Sublimat Loesung als desinfizierendes Mittel und ihre Verwendung in Verbandstoffen. *Deutsche med Wchnschr* 1887 13 868
- 19 LOCKWOOD Aseptic Surgery. London Oxford University Press 1909
- 20 LUTHER F Die Hydrolyse des Quecksilber Chlorids. *Ztschr f physikalische Chemie* 1904 47 107
- 21 MADSEN and NYMAN Sur Theorie der Desinfection. *Ztschr f Hyg u Infektionskrankh* 1907 57 388
- 22 MCFARLAN The germicidal value of potassium mercuric iodide. *J Am M Ass*, 1914 62 17 *Am J M Sc*, 1920 150 586
- 23 McKENNA W F, and FISHER H A The use of potassium mercuric iodide for skin disinfection. *Surg Gynec & Obst* 1920 30 370
- 24 MIQUEL (1883-84) Cited by Sternberg (1893)
- 25 MUELLER A Die Resistenz der Milzbrandsporen gegen Chlor, Pichelsaure, Formaldehyd und Sublimat. *Arch f Hyg*, Munich and Berlin 1920, 89 363
- 26 PARK W H Bacteriology in Medicine and Surgery. New York Lea Bros 1899
- 27 PRICE P B New studies in surgical bacteriology and surgical technic etc. *J Am M Ass* 1938 111 1993
- 28 Idem The bacteriology of normal skin, etc. *J Infect Dis* Chicago 1938 63 301
- 29 Idem Ethyl alcohol as a germicide. *Arch Surg* 1939, 38 528
- 30 RABIN O Physiology of Bacteria. Philadelphia Blakiston's Son & Co, 1932
- 31 ROSENWALD K Ueber die Widerstandsfähigkeit von Gelbfeuchtholera und Streptokokken gegenüber Sublimat Carbonsäure und Trypaflavin. *Ztschr f Hyg u Infektionskrankh* 1923 99 117
- 32 STERNBERG C V A Manual of Bacteriology. New York Wm Wood & Co, 1893
- 33 SUEPPE K, and MUELLER A Ueber die Rolle der Adsorption bei der Einwirkung von Sublimat auf Bakterien. *Arch f Hyg* Munich and Berlin, 1920 89 350
- 34 VON BEHRING. *Deutsche med Wchnschr*, 1889 15 837 869 884
- 35 WATSON C H An improved substitute for iodized catgut sutures. *Surg Gynec & Obst* 1916 22 114
- 36 WELCH W H Conditions underlying the infection of wounds. *Tr Cong Am Phys & Surg* 1892, 2 128

THE MAINTENANCE OF LIFE DURING EXPERIMENTAL OCCLUSION OF THE PULMONARY ARTERY FOLLOWED BY SURVIVAL

JOHN H. GIBBON, Jr., M.D., Philadelphia, Pennsylvania

THE remarkable advances made in thoracic surgery in recent years have been accompanied by progress in surgery of the heart. The experimental demonstration of the nature of Pick's disease (2) and its operative cure (2, 4, 19, 20) constitute a past chapter in the history of cardiac surgery. The repair of wounds of the heart is being accomplished with an increasingly lowered mortality rate (8). Recently a method of establishing a collateral blood supply for the myocardium when the coronary vessels become occluded has been demonstrated upon animals (3, 16) and applied successfully to patients (1). However, attempts to carry out surgical procedures within the cardiac chambers or great vessels at the base of the heart have not been attended as yet with much success. The Trendelenburg operation of pulmonary embolotomy is associated with a discouraging mortality (14) and has not yet been successfully accomplished in this country. Surgical procedures designed to relieve a stenosis of the mitral valve have been even less successful (5).

It is obvious that any operative procedure upon the heart could be performed better if that organ were temporarily relieved of its function of pumping blood. For example, if the flow of blood through the heart and lungs could be safely stopped for 30 minutes, it is conceivable that a new field of cardiac surgery might be developed.

In order to maintain life during such a temporary cessation of blood flow through the heart and lungs it is necessary to assume the functions of these organs by some other means. This might be accomplished, as suggested by Phemister, by continuously injecting arterial blood from a number of suitable donors into

the arterial system of the patient, while at the same time continuously withdrawing venous blood from the patient and injecting that venous blood into the same donors. The complexities of such a procedure and the difficulties of obtaining a number of individuals willing to undergo the procedure are apparent. Obviously it would be more desirable to assume the functions of the heart and lungs temporarily by a mechanical apparatus. Some of the difficulties and complexities would still be present, but if they could be overcome, the advantages of such a mechanical apparatus are easily seen.

The problem which presented itself to us was largely one of adapting one or more of the various perfusion methods which have been used in the past in the study of isolated organs. Indeed, there would be no problem at all except that of the increase in size of the apparatus, if large tubes could be tied into the aorta and into the vena cava, as is done with the main artery or vein of an isolated organ. However, if the functions of the heart and lungs are assumed only temporarily by a mechanical apparatus, these large vessels cannot be divided and ligated for cannulation. The perfusion must be carried out through smaller peripheral vessels. Oxygenated blood must reach the aorta by a reverse flow through one or several peripheral arteries. These arteries must be so small that after removal of the perfusing cannulas their ligation does not entail any damage to the peripheral tissues which they supply. Perhaps if a sufficient number of small arteries were used, the vessels might be punctured with needles and heal without requiring ligation.

Similarly, a rapid free flow of venous blood must be obtained from the main venous reservoirs of the body by way of one or more peripheral veins. Veins must be employed in

From the Harrison Department of Surgical Research, School of Medicine, University of Pennsylvania.

Aided by a grant from the Josiah Macy, Jr. Foundation, New York.

which no valves are interposed between the point of needle puncture or cannulation and the large intrathoracic veins. Here an additional problem presents itself in that a much more rapid flow of blood must be established through small vessels with collapsible walls than obtains under normal circumstances. Thus, unless a relatively enormous number of peripheral veins without valves are employed for needle puncture the walls of the veins so used will collapse. A simpler method is to use a rigid walled cannula. The cannula must be of such a bore that it may be inserted into a small peripheral vein, and must be long enough to reach a vein of large caliber, where the flow of blood will not be so rapid as to induce collapse of its walls. On withdrawal of the cannula the vein may be ligated. This requirement for using small arteries and small veins for the perfusion increases the difficulties of the procedure, and constitutes the only essential difference between perfusion of isolated organs and the temporary assumption of the functions of the heart and lungs of a whole animal.

The successful assumption of the functions of the heart and lungs of an animal by purely mechanical means and by the use of small peripheral vessels, has already been described (9). However, in only 3 instances were the animals able to resume their normal cardio-respiratory functions after the period of perfusion. In these 3 animals the pulmonary artery was completely occluded, hence the flow of blood through the heart and lungs completely stopped for periods of 30, 33, and 39 minutes. During the period in which the pulmonary artery was occluded, life was maintained by perfusion of the animal through a small artery and a small vein. The pulmonary artery was then released, thus allowing blood once more to flow through the heart and lungs, and the perfusion was stopped. None of these animals survived for more than 4 hours after the perfusion had been stopped. The present communication deals with further development of this method and reports prolonged survival after short periods of temporary occlusion of the pulmonary artery.

Many excellent devices have been described for pumping blood through a perfusion circuit. The one which was thought to be most suit-

able for our purpose was that described by Dale and Schuster, the essential feature of which is a rubber finger cot which is alternately compressed and expanded by air. Such a pumping arrangement requires the insertion of one way valves in the blood circuit in order to direct the flow of blood. A modification of this Dale Schuster pump was used originally (9). In the course of that work an article appeared by DeBakey describing a constant injection roller type of pump which he employed in blood transfusions. This pump eliminated the necessity for valves, and a modification of it driven by an electric motor has been adopted in the work here reported.

A great many methods for introducing oxygen rapidly into the blood have been developed in connection with the perfusion of isolated organs. Their chief disadvantage for use in our problem was that they all required a large quantity of blood in relation to the surface area afforded for oxygenation. Consequently, in the work reported earlier (9) and in the present report an oxygenator has been used which has a large surface volume ratio (10). It was designed expressly for use in this work. It has this added advantage that there is little or no trouble with frothing or foaming, an undesirable feature often present in other oxygenators which have been described.

APPARATUS

The procedure employed was essentially similar to that previously reported (9). Venous blood was withdrawn from the superior vena cava through a cannula in the right jugular vein, oxygenated, and reinjected through a cannula in the right carotid artery in a central direction.

The apparatus used to oxygenate the blood has already been described (10). The essential features are indicated diagrammatically in Figure 1, and the apparatus is shown in Figure 2. The stream of blood is directed against the inner surface of a rapidly revolving cylinder, *A*, where it is spread into a thin film by centrifugal force. This film moves downward by gravity and is collected in a stationary cup, *B*, at the bottom of the cylinder. The cup, *B*, is funnel shaped and the opening at the bottom is continuous with the lumen of a

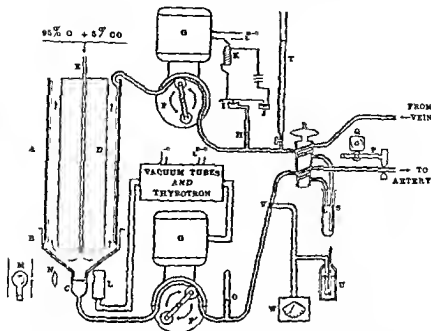


Fig 1 Diagram not drawn to scale of the extracorporeal circuit used to draw venous blood introduce oxygen and return the blood to the arterial system. For description see text.

glass cup with vertical walls *C*. Most of the space within the revolving cylinder *A* is occupied by a stationary cylinder *D*. This cylinder *D* is closed at both ends except for a tube *E* which serves to convey a mixture of 95 per cent oxygen and 5 per cent carbon dioxide to the bottom of the oxygenator. This gas mixture is blown through the apparatus at the rate of 5 liters a minute and passes upward between cylinders *A* and *D* to escape at the top of the apparatus.

The blood is moved through the circuit by 2 pumps. The pump, *F*, transfers blood from the superior vena cava to the oxygenator. The pump, *F'*, returns the oxygenated blood to the animal's aorta through the centrally directed cannula in the right carotid artery.

The pumps used to move the blood through the circuit are of the constant injection roller type. The objection to these pumps has always been that the rubber tubes compressed by the rollers gradually move forward as the rollers pass over them. To avoid this "creeping," DeBakey employed rubber tubes with a projecting flat rubber flange. The flange is clamped between 2 semicircular metal bars

This device holds the tube firmly in position and prevents any forward movement as the rollers pass over and compress the tubing. This improvement of DeBakey was incorporated in the design of the pumps *F* and *F'*, but is not indicated in Figure 1. Each pump accommodates 3 rubber tubes arranged in a tier, one above the other. The 3 tubes are compressed simultaneously by each roller. The pumps are driven by shunt wound one tenth horse power direct current electric motors, *G* and *G'*. The motors are geared to the pumps by speed reducers with a ratio of 20 to 1. The speed of the motors and thus the output of the pumps is controlled by a rheostat which varies the current flowing through the armatures of the motors.

If blood is withdrawn from the superior vena cava by the pump *F*, more rapidly than it enters that vein from its tributaries the wall of the vena cava is drawn against the opening of the cannula. Unless the pump is immediately stopped, the wall of the vein continues to be held in this position, and the extracorporeal circulation comes to an abrupt end. It was necessary to provide for an instantaneous ces-

sation of the sucking action of the pump, *F*, whenever this occurred. This was accomplished by introducing a vertical T-tube, *H*, between the pump, *F*, and the cannula in the jugular vein. The upper end of this T tube is connected with a membrane manometer, *I*, which supports a lever above a small cup of mercury, *J*. When the tip of the lever comes in contact with the mercury, an electrical circuit is completed through a relay, *K*, which cuts off the current to the motor, *G*, driving the pump, *F*. With such an arrangement, whenever the wall of the vein occludes the tip of the venous cannula, the blood level in the T-tube, *H*, abruptly falls, lowering the air pressure in the membrane manometer *I*. By means of the relay, *K*, the current to the motor, *G*, driving the pump, *F*, is interrupted. The pump immediately stops, suction ceases, and the wall of the vena cava is drawn away from the tip of the cannula by the filling of the vein with blood. The level of blood in the T-tube, *H*, then rises, the above process is reversed, and the pump, *F*, resumes action. When such a sequence of events occurs it is an indication that the pump, *F*, is withdrawing blood from the vena cava more rapidly than blood is entering that vein. Hence the speed of the pump is decreased by reducing the current flowing through the armature of the motor, *G*. During the course of an experiment the intermittent action of the pump, *F*, produced by the above sequence of events, would occasionally go unnoticed. Therefore, a small electric bell was inserted in the relay circuit. This is not indicated in Figure 1. When the bell rings, the operator knows that the speed of the pump, *F*, should be reduced.

It is essential that the output of the pump, *F*, correspond exactly to the amount of blood entering the cup, *C*, at the bottom of the oxygenator. If blood is pumped from the cup, *C*, more rapidly than it enters, the level of blood in the cup falls and air bubbles are drawn into the tubing and so driven into the animal's artery with resultant arterial air embolism. On the other hand, if the pump removes blood from the cup, *C*, more slowly than blood enters from the oxygenator, there is a gradual accumulation of blood in the cup with resultant depletion of blood in the animal's

vascular system. This produces a fall in blood pressure and proves as disastrous as air embolism. These difficulties could not be overcome by driving both pumps, *F* and *F'*, at the same speed, because small variations in the diameter of the tubes compressed by the pumps, or differences in the resistance offered to the outflow or the inflow of either pump would still produce an inequality in output between the 2 pumps. Hence it was essential that the output of the pump, *F'*, be regulated solely and completely by the level of the blood in the cup, *C*, at the bottom of the oxygenator.

It is possible to regulate the output of the pump, *F*, by hand so that the level of blood in the cup remains constant and neither of these undesirable and often fatal events occur. However, this requires the undivided attention of one assistant during the whole period of perfusion, and the slightest relaxation of attention on his part may result in the death of the animal. A more satisfactory and completely automatic control of the pump, *F'*, was obtained by using a photo electric cell, *L*, vacuum tube amplifiers, and a thyatron tube.¹

The photo electric cell, *L*, is placed behind the glass cup, *C*, at the bottom of the oxygenator. A strong beam of light from a 100 Watt bulb, *M*, is concentrated by a lens, *N*, and directed through the glass cup to the photo electric cell, *L*. The current from the photo electric cell is amplified by 2 vacuum tubes in series. The amplified current saturates a reactor, which in turn shifts the phase of the alternating current grid voltage with respect to the alternating current plate voltage, resulting in varying plate current from the thyatron. This plate current then flows through the armature of the shunt wound direct current motor, *G'*, geared to the pump, *F'*. A rise in the level of the blood in the cup diminishes the amount of light reaching the photo electric cell and produces an increase in the speed of the electric motor driving the pump, *F'*. Conversely, when the level falls, more light reaches the photo electric cell and the output of the pump, *F'*, is diminished. With this arrangement the level of the blood in the cup does not vary more than a few millimeters even with wide

¹ I am indebted to Dr. Carl C. Chambers of the Moore School of Electrical Engineering of the University of Pennsylvania for designing this electrical circuit.

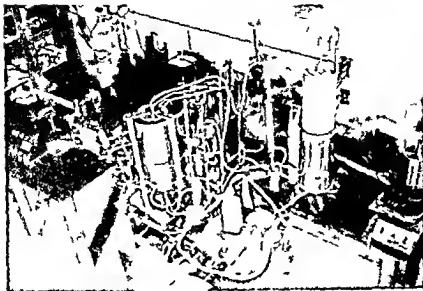


Fig. 2 Photograph of the apparatus showing in the center the revolving cylinder of the oxygenator and the 2 blood pumps. To the left are vacuum tube amplifiers and thyatron and to the right the closed oxygen rebreathing circuit connected with a bell spirometer filled with oxygen.

variations in the output of the pump, F . When the pump F stops the pump F' stops also, always maintaining the same level of blood in the cup C at the bottom of the oxygenator.

The flow of blood on the output side of the pumps is not perfectly smooth. Slight pulsations are produced each time the rollers begin or cease to compress the tubing. The rate of these pulsations varies with the output of the pumps, being more rapid as the output increases. Thus at the slowest speed there are 6 pulsations a minute and at the highest 220. A pulsatile pressure in arteries has been shown to be essential to the normal function of organs (13). However the wide variations in pulse rate occurring with variations in the output of the pumps were thought to be undesirable. Therefore the pulsations from the pump F' are eliminated by introducing a T tube O with a long wide upright portion into the circuit just beyond the pump F . The end of the vertical limb of the tube is closed. This air cushion eliminates pulsations and gives an almost smooth flow. A pulsatile flow into the carotid artery is produced by a horizontal bar, P , which compresses the tubing leading to the arterial cannula at the rate of 150 times a minute. This approximates a cat's heart rate

under ether anesthesia. The intermittent compression of the tubing is accomplished by the revolution of a square wheel, Q , with rounded corners which forces the bar downward across the tubing 4 times with each revolution. The wheel is geared to an electric motor so that the rate of the pulsations in the tubing can be adjusted to the desired speed.

It is essential to maintain a constant volume of blood in the animal's vascular system. To do this it is necessary to start withdrawing blood from and injecting blood into the animal at the same instant and at the same rate. This is accomplished by passing both venous and arterial blood through the same stopcock, R . The stopcock contains 4 internal channels, 4 outlets on one side and 2 outlets on the other side. With the stopcock R , in the position shown in Figure 1, the extracorporeal circuit is connected with the tubes leading to the arterial and venous cannulas, and in the reverse position the circuit is connected with 2 tubes entering a small test tube, S . Prior to perfusing the animal the extracorporeal circuit is filled through the burette T with heparinized blood previously obtained from another cat. This blood is then slowly moved around the circuit by the pumps with the oxy-

generator cylinder, *A*, revolving. The blood is pumped from and into the small test tube, *S*. The purpose of this is to stabilize temperature conditions throughout the circuit. When the operative procedures in the animal are completed, a single half turn of the stopcock, *R*, connects the extracorporeal blood circuit with the animal's own circulation. The circuit itself is so devised that it always holds a very constant volume of blood, due in large part to the photo electric cell control of the pump, *F*. By these means it is possible to maintain a constant volume of fluid in the animal's vessels.

The blood is maintained at body temperature during its passage through the extracorporeal circuit by surrounding as much as possible of the apparatus with a moving stream of warm water. For the sake of simplicity this water jacket is omitted from Figure 1. Three portions of the blood circuit are surrounded by the water bath. Between the glass stopcock, *R*, and the pump, *F*, the blood passes through a glass tube in a Leibig condenser. The stationary cup, *BC*, at the bottom of the oxygenator consists of 2 portions. The upper part, *B*, is of metal and has a double wall, the small, lower portion of the cup, *C*, is of glass and also has a double wall. Warm water is continuously circulated through the Leibig condenser and between the walls of the stationary cup, *BC*, in both its metal and glass portions.

In addition to this warming of the blood circuit, the cold dry gas from a cylinder of 95 per cent oxygen and 5 per cent carbon dioxide is warmed by passing it through a spiral tube immersed in the warm water reservoir. The gas is then saturated with water vapor by bubbling it through the warm water. To prevent condensation the warm gas saturated with water vapor is passed through warm tubes until it enters the oxygenator. Water is pumped to and from a 4 gallon water reservoir through the water jacket at the rate of 850 cubic centimeters per minute. The water bath is heated by a 500 watt knife type immersion heater. The temperature is controlled by a thermostat inserted into the water bath which, acting through a relay, controls the current to the knife heater. The thermostat

maintains the temperature of the water bath within a plus or minus 0.5 degree C.

The animal's rectal temperature, the temperature of the blood passing through the circuit, and the temperature of the water bath are recorded at 3 minute intervals during the course of an experiment. Thermocouples are used instead of mercury thermometers, because of the rigidity with which they follow fluctuations of temperature and, in the case of the blood circuit, because it was simpler to insert a small wire in the blood stream than it was to immerse the large bulb of a mercury thermometer. All 3 temperatures can be read by an assistant at some distance from the operative field and the apparatus, a consideration of some importance when the operations are performed under sterile conditions. Copper constantan junctions are used for thermocouples, the control junctions are placed in a thermos bottle, *U*, containing mineral oil and the testing junctions are inserted into the animal's rectum, the blood circuit, *V*, and the water bath circuit, respectively. The readings are made on a scale at a distance of 1 meter from a mirror type d'Arsonval galvanometer, *W*. The external resistance for critical damping is placed as a shunt across the galvanometer posts and a suitable resistance is placed in series with the thermocouples so that a deflection of 1 millimeter of the hair line on the scale corresponds to a change of temperature of 0.1 degree C. With water at a temperature of 39.5 degrees to 40.0 degrees C circulating through the 3 jackets described, the temperature of the blood in the circuit is maintained at approximately 38.5 degrees C. Under these circumstances the rectal temperature is maintained at 38.0 degrees C or above.

The extracorporeal circuit, with the oxygenator cylinder, *A*, revolving, holds 65 cubic centimeters of fluid. The fluid is distributed as follows: 35 cubic centimeters on the inside of the revolving cylinder, *A*, and the inside of the cup, *B*, 10 cubic centimeters in the cup, *C*, and 5 cubic centimeters in the test tube, *S*. The remaining 15 cubic centimeters are distributed throughout the tubing in the rest of the circuit.

In the experiments reported here the circuit was always filled with blood from another

cat prior to the experiment. The blood was obtained under sterile precautions from a donor cat, usually the day before, and an equal volume of salt solution was given the donor animal to replace the blood loss. Large cats, 3 or 4 kilograms in weight, were used as blood donors, and a blood loss of 65 or 70 cubic centimeters, representing approximately a fifth of their total blood volume, was without with very little disturbance. The animal was given 10 milligrams of heparin per kilogram of body weight prior to the withdrawal of the blood. The heparin used was obtained from the University of Toronto and contained 15 units per milligram. The blood which was obtained was kept in a sterile flask in an icebox until the following morning when it was used.

The pumps are capable of delivering approximately 300 cubic centimeters of fluid per minute. As has been mentioned the flow through the extracorporeal circuit is regulated by varying the speed of the pump, F . As the pump F follows passively the variations in output of the pump E , the rate of flow of blood through the entire extracorporeal circuit can be regulated by the rheostat controlling the speed of the motor, G . By collecting and measuring the volume of fluid delivered by the pump F , at different rates of revolution of the pump, the volume delivered by one revolution of the pump was found to be constant at all rates of revolution. It was consequently a simple matter to calibrate the rheostat so that flow of blood through the circuit at any moment can be accurately determined from the position of the rheostat.

METHOD

The cat was used in these experiments because its oxygen requirement is small and the oxygenator which had been built did not introduce enough oxygen into venous blood to maintain life in a larger animal. In all the experiments reported in this paper the blood flow through the heart and lungs was completely stopped for varying lengths of time by clamping the pulmonary artery. During the period in which the pulmonary artery was occluded, life was maintained by continuously withdrawing blood from the superior vena

cava, oxygenating this blood, and injecting the oxygenated blood into the aorta by way of the carotid artery. Thus the extracorporeal circuit temporarily performed the functions of the animal's heart and lungs.

In the cat the lungs completely overlie the pericardium, and in order to expose the pulmonary artery artificial respiration must be employed, because the left pleural cavity has to be opened. This was an undesirable feature in these experiments, as it precluded the observation of natural respiratory movements when the pulmonary artery was occluded. To obviate this difficulty, a preliminary operation was performed 6 weeks before the cats were to be used in the perfusion experiments. This preliminary operation consisted of suturing the pericardium directly beneath the skin so that later the pulmonary artery could be rapidly exposed without opening the pleural cavity. Artificial respiration and anesthesia were maintained by the intermittent insufflation of air and ether vapor through a catheter inserted in the trachea through the mouth. A portion of the pectoralis major and minor muscles overlying the fourth and fifth costal cartilages was removed and these cartilages together with bits of the adjacent ribs were resected. The left pleural cavity was opened through the bed of the fifth costal cartilage and rib. The portion of the pericardium overlying the pulmonary artery was then sutured to the margins of the opening in the chest wall with interrupted sutures of fine silk, and the skin incision was closed. This procedure made it possible some 6 weeks later to expose the pulmonary artery in a normally breathing animal by merely incising the skin and the underlying pericardium.

For the perfusion experiments the cats were anesthetized with ether. A catheter was inserted in the trachea through the mouth, and connected with a closed circuit containing 2 Krogh respiratory valves, a soda lime chamber, a distensible rubber bag, a spirometer containing oxygen and an ether vapor bottle. The use of this carbon dioxide absorption technique permitted a more easily controlled anesthesia than did the simpler open-drop ether method and ensured the avoidance of anoxemia throughout the period of anesthesia.

The skin and parietal pericardium overlying the pulmonary artery were incised. The pulmonary artery was dissected free from the aorta and a graduated clamp (11) with its jaws open was put in place about the pulmonary artery. A small incision was then made on the right side of the neck and the right external jugular vein and the right common carotid artery were isolated. Ten milligrams, or 150 units, of heparin per kilogram of body weight, dissolved in sterile saline, was injected into the jugular vein. The artery was then ligated and a glass cannula was inserted caudad to the ligature pointing toward the aorta and tied in place. The cannula and tubing were previously filled with saline to avoid the introduction of air into the circulation. Similarly the external jugular vein was ligated and a venous cannula of stainless steel was passed through the external jugular vein down to the superior vena cava.

The venous cannulas used were made of stainless steel tubing with a very thin wall and an internal diameter of approximately 1.5 millimeter. The cannulas had 2 slight curves to correspond to the shape of the external jugular and innominate veins. They were 7 centimeters long. When tied in place, the tip of the cannula lay in the superior vena cava just beyond the junction of the innominate veins. To obtain the proper curvature of these venous cannulas, a Wood's metal mold of these veins had been made in a cat of average weight. The curves allowed the cannula to lie without tension in a position conforming to the normal course of the veins. This was of some importance because it was necessary to have the open tip of the cannula pointing caudally in the approximate center of the upper portion of the superior vena cava. If the tip of the cannula lay against or close to the wall of the vena cava, the vein wall was drawn into the tip of the cannula when very slight degrees of suction were exerted. The cannula had to be long enough to extend into the superior vena cava, as it was found to be extremely difficult to obtain an adequate flow of blood through the cannula when the tip lay in the jugular or innominate veins.

Before the operative work on the animal was begun, the extracorporeal circuit was

thoroughly rinsed by pumping 2 liters of physiological saline through the apparatus. A 1:1000 aqueous solution of metaphen was then circulated through the apparatus for 20 minutes. The metaphen was washed out of the circuit with 2 liters of sterile physiological saline. Blood from the donor cat was then introduced and pumped slowly, at 100 cubic centimeters per minute, through the circuit until the temperature of the blood reached 38.5 degrees C. Shortly before the circuit was to be connected with the animal, a flow of 95 per cent oxygen and 5 per cent carbon dioxide was started through the oxygenator at the rate of 5 liters per minute. Faster rates of flow did not prove more effective in oxygenating venous blood. When the blood had reached the proper temperature and the operative procedures had been completed, the stopcock, R, was turned connecting the artificial circuit with the animal's vascular system.

After the extracorporeal circuit was connected with the animal and the donor blood had thus been mixed with that of the experimental cat, the pulmonary artery was gradually occluded by the clamp. During this time the rate of flow of blood through the extracorporeal circuit was gradually increased so that when the pulmonary artery was completely occluded the rate of flow of blood through the apparatus was approximately 100 cubic centimeters per minute per kilogram of body weight. Smaller rates of flow were generally found to be insufficient to maintain an adequate blood pressure, and it was difficult to obtain rates of flow appreciably higher than this.

In order to maintain anesthesia while the pulmonary artery was completely occluded, it was necessary to pass ether vapor through the oxygenator. The use of barbiturates intravenously or intraperitoneally would have obviated this necessity, but these anesthetics generally tended to depress the blood pressure and recovery from them was always unduly prolonged. Ether did not depress blood pressure and recovery from the anesthetic was rapid. The transference from ether vapor in the lungs to ether vapor in the oxygenator was made at the start of the compression of the

pulmonary artery by shutting off the supply of ether to the closed respiratory circuit and introducing ether vapor to the stream of oxygen going to the oxygenator. With care an adequate depth of surgical anesthesia could be maintained during the transference of ether vapor to the oxygenator and during the period of complete occlusion of the pulmonary artery. When the pulmonary artery was released the procedure was reversed i.e. ether vapor was again introduced into the closed respiratory circuit connected with the intratracheal catheter and was shut off from the stream of oxygen entering the oxygenator. It was necessary to maintain an even level of anesthesia as any movements on the part of the animal were apt to produce occlusion of the tip of the venous cannula and cessation of blood flow through the circuit. With experience a skilled anesthetist could maintain an adequate even level of anesthesia throughout the procedure.

The complete occlusion of the pulmonary artery was maintained for periods of from 10 to 25 minutes inclusive in the experiments here reported. At the end of this interval the clamp was removed from the pulmonary artery. The flow of blood through the extracorporeal circuit was gradually decreased and, after a few minutes was stopped completely at which time the animal's heart and lungs again took over their normal functions. At this time a sample of blood was withdrawn for a hematocrit determination. The cannulas were removed from the carotid artery and external jugular vein these vessels were ligated and the skin sutured. The wound in the chest was closed by approximating the parietal pericardium with several interrupted silk sutures and the skin was closed without drainage. The postoperative convalescence of these animals was not remarkable. In several instances 100 cubic centimeters of 5 per cent glucose in physiological saline were given intraperitoneally for a day or so after operation.

RESULTS

Thirty four experiments were performed under non sterile conditions to test the new apparatus and to study survival of animals up to 8 hours. In these experiments the pulmonary artery was completely occluded, usu-

ally for 30 minutes, while the extracorporeal circuit maintained life in the animal's tissues. At the end of this time the clamp was removed from the pulmonary artery, the cannulas were removed from the neck, and the wound were sutured. The animals were then observed and if alive at the end of 6 or 8 hours, were sacrificed. Kymograph records were made of the blood pressure and respiration during the occlusion of the pulmonary artery while life was maintained by the extracorporeal circuit. In the course of these acute experiments many technical difficulties were solved, and it was demonstrated that the new apparatus was more efficient than the one previously described (9).

In 39 cats the pulmonary artery was completely occluded and life maintained by the extracorporeal circulation with complete aseptic precautions. In 13 instances with periods of occlusion of the pulmonary artery of from 10 to 25 minutes inclusive the animals survived 24 hours or more. Table I gives the details of these 13 experiments. An average of 10 minutes was taken to compress the pulmonary artery. The time was somewhat shortened in the later experiments. It would of course have been possible to occlude the pulmonary artery suddenly, and to start the flow of blood through the artificial circuit abruptly. However such a procedure would have resulted in a temporary fluctuation in blood flow and blood pressure and some disturbance in the level of anesthesia. It was found more satisfactory to occlude the pulmonary artery slowly and while doing so to increase the flow of blood gradually through the extracorporeal circuit. This gradual occlusion allowed the anesthetist to maintain an even depth of anesthesia during the transference of ether vapor from the animal's lungs to the oxygenator.

The periods of complete occlusion of the pulmonary artery were not long because of the difficulty in supplying an adequate amount of oxygen. The blood which returned to the animal's aorta was frequently not bright red. Hence it is probable that throughout the period of occlusion of the pulmonary artery there was always some degree of anoxemia and anoxia of the animal's tissues. This difficulty

was due to the fact that the surface for filming of blood in the oxygenator, 2300 square centimeters, was not large enough for the rates of blood flow used. An oxygenator with a 75 per cent increase in filming surface is being constructed at present, and it is hoped that it will correct this difficulty.

After the clamp was removed from the pulmonary artery the flow of blood through the extracorporeal circuit was continued at a gradually diminishing rate for an average period of 11 minutes. The object of so doing was to relieve the right ventricle, which was always somewhat distended during the period of occlusion, of the sudden burden of resuming immediately its entire function. The necessity, however, for such a period of partial aid to the heart following the occlusion of the pulmonary artery has not been conclusively demonstrated.

The average rate of blood flow through the extracorporeal circuit during complete occlusion of the pulmonary artery was 242 cubic centimeters per minute, while the rate per kilogram of body weight averaged 99 cubic centimeters per minute. Rates of flow below 100 cubic centimeters per kilogram of body weight per minute were generally inadequate to maintain normal blood pressure. The relationship between the blood pressure and the flow of blood per kilogram of body weight through the extracorporeal circuit was borne out by observations in 14 non sterile experiments. In these experiments the blood pressure was recorded directly from the femoral artery by a mercury manometer. Forty six simultaneous readings were made of the systemic arterial blood pressure and the flow of blood through the extracorporeal circuit. When these points were plotted there appeared roughly to be a direct relationship between the flow through the circuit and the blood pressure, although, to be sure, many other factors are involved in the maintenance of the blood pressure. Consequently, an attempt was made in all experiments to maintain a flow through the extracorporeal circuit of 100 cubic centimeters per kilogram of body weight or more per minute.

The blood pressure was not recorded in the sterile experiments. Direct blood pressure

readings would have required a third operative wound and the ligation of another peripheral artery at the end of the experiment, in addition to the necessity of maintaining sterility of the fluid in the circuit leading to the mercury manometer. Some time was spent in attempting to obtain satisfactory, indirect blood pressure readings by the use of pneumatic cuffs on the animal's hind limbs. Good correlation was obtained between this indirect method and direct readings with large ranges of blood pressure in the normal cat. However, the method failed to produce satisfactory readings during complete occlusion of the pulmonary artery. This was probably due to a combination of intense vasoconstriction and an insufficient pulse pressure. The cuff method used was dependent upon a large pulse pressure for accurate readings.

There was usually some anemia at the conclusion of the experiments. In the 13 observations recorded in Table I the hematocrit readings at the end of the experiment varied between 25 and 40 per cent with an average value of 32 per cent. Hematocrit readings were also made after the operative work had been completed and before the animal had been connected with the extracorporeal circuit in 25 experiments. These readings varied between 25 and 44 per cent with an average value of 36.4 per cent. Hence for the most part anemia was present prior to beginning the perfusion.

In discussing the length of time these animals survived the experiments, it is convenient to divide them into 3 groups. The first group consists of 5 cats that survived from 24 to 48 hours, (experiments Nos. 9, 30, 31, 37 and 39). The chief factor in the death of these animals was undoubtedly anoxemia during the period of occlusion of the pulmonary artery due to inadequate oxygenation of the blood in its passage through the circuit. Lowered blood pressure, shock, and fatal lowering of the body temperature were contributory factors. The second group consists of 4 cats that lived a week or more (experiments Nos. 13, 15, 27, and 28). No. 15 was sacrificed on the eighth day because of purulent pericarditis. Pericarditis developed in No. 28, and was drained on the thirteenth postoperative day. Despite this the cat died 2 days later. No. 27 died on

the twenty second day from a severe case of distemper. No 13 died on the twenty third day after having developed very intense jaundice. Extensive hepatic necrosis was found at autopsy. The third group consists of 4 cats that survived more than a month in a healthy condition (experiments Nos. 16, 20, 34, and 38). No 20 was alive and perfectly well 34 days after a 20 minute period of complete occlusion but was unfortunately sacrificed at that time by another investigator through a mistake in identification. The 3 remaining animals are alive and well, 12, 9, and 0 months respectively after the experiment. These cats appear normal in every respect and show no neurological changes or abnormalities in behavior. One of these, No 16, has had a litter of kittens since the experiment.

A number of control experiments have been performed in which the pulmonary artery was occluded under identical circumstances with the exception that the extracorporeal circulation was not employed. In these controls, which will be reported in detail elsewhere, regular respirations ceased within 40 seconds of complete occlusion of the pulmonary artery. There was an occasional solitary gasping respiration after the cessation of regular respiratory movements. Such isolated respiratory gasps were never observed after 3 minutes of complete occlusion. The blood pressure fell rapidly to zero within 30 seconds and remained at this level throughout the period of occlusion. Coincident with the fall in blood pressure the retinal arteries contracted and could be seen only as thin lines. There was a slow movement in the retinal veins associated with a beaded appearance which persisted for a minute or so. This movement in the retinal veins also ceased completely after 3 minutes of occlusion. Under the conditions of the observations if the clamp was removed from the pulmonary artery after 3 minutes of occlusion a spontaneous restoration of the blood pressure and resumption of respirations occurred. With longer periods of occlusion it was necessary to employ artificial means in order to restore cardiac and respiratory action. The means used were the intra arterial injection of adrenalin and coramine in a central

direction, washed in with 10 or 15 cubic centimeters of salt solution and, when necessary, artificial respiration and cardiac massage. These were found to be the most effective methods of resuscitation. Even with the employment of these measures it was found impossible to initiate either respiratory or cardiac action after a period of occlusion of the pulmonary artery of 10 minutes. Permanent neurological damage has been found to exist after periods of occlusion of 4 minutes as will be reported later in detail. In the observations with the extracorporeal circulation reported here none of these methods of resuscitation were employed or were necessary. With the extracorporeal circuit the respirations were regular, although often slightly more rapid and of greater depth throughout the period of occlusion and the heart continued to beat strongly and at a regular rate throughout.

CLINICAL POSSIBILITIES

As far as we are aware this constitutes the first report of the successful temporary substitution of an entirely mechanical apparatus for the functions of the heart and lungs of an animal followed by the prolonged survival of the animal. It is hoped that the method may eventually be perfected to such an extent that it may be safely employed on human beings. The difficulties do not seem to be insurmountable with regard to such an application. Heparin now has been purified greatly and is without toxic effects when given intravenously to human beings. Murray and Best have already prolonged the coagulation time of the blood to two or three times its normal value in patients for a number of days. Knoll and Schurch have rendered the blood of donors incoagulable by the injection of heparin prior to withdrawing blood for transfusion. In these patients after fairly large doses of heparin the coagulation time of the blood returned to normal limits within 150 minutes. That it is possible to perform an operation on an animal whose blood has been rendered incoagulable by heparin has been demonstrated in the experiments here reported. Silk technique has been used throughout and careful attention to hemostasis has been employed. The wounds in the chest and the neck have been closed with

TABLE I—SUMMARY OF THIRTEEN EXPERIMENTS

Experiment Number	Weight of cat kg	Time of occlusion of pulmonary artery		Time artificial circulation continued after release min	Time required for experiment min	Blood flow through circuit during complete occlusion		Hematocrit at end of experiment per cent	Time of survival days
		Partial min	Complete min			Rate—ccm per min	Rate per kg body weight—ccm per min		
9	2.25	12	15	16	108	225	100	28	1
13	2.2	12	10	11	143	140	100	30	23
15	1.0	15	10	13	132	190	100	32	8
16	2.85	10	12	5	114	50	88	33	370+
20	3.2	11	20	18	117	270	84	32	34
27	2.6	12	10	9	92	108	76	40	22
28	3.3	6	12	14	107	280	85	34	15
30	2.3	7	15	14	98	235	102	36	2
31	2.2	6	15	12	96	250	127		1
34	2.55	8	13	11	89	255	100	34	293+
37	2.8	8	25	8	95	260	96	34	1
38	2.1	5	18	7	97	234	111	25	270+
39	2.1	4	15	9	98	230	109	27	2
Averages	2.5	10.4		11.3	106	242	99	32	

+Animals still living

out drainage and no hematomas have developed. The only infections encountered were 2 instances of purulent pericarditis (experiments Nos. 15 and 28), and it is difficult to attribute these to the use of heparin.

The possible uses of such an extracorporeal circulation in humans may be briefly noted. If it were not at first feasible to carry an entire circulation with an oxygen requirement of 200 cubic centimeters per minute or more, it might be valuable temporarily to take over a small part of the cardiorespiratory functions in an acutely failing heart from whatever cause, where the possibility exists that the heart and lungs may again be able to assume their full burden. In patients with massive pulmonary embolism, even without carrying the entire circulation, the extracorporeal circuit might make the difference between life and death until a pulmonary embolectomy could be done to remove the embolus. And finally, if the entire circulation could be carried temporarily by an extracorporeal circuit, it is conceivable that a diseased mitral valve might be exposed to surgical approach under direct vision and that the fields of cardiac and thoracic surgery might be broadened.

SUMMARY

1. A method has been described by which life can be maintained in animals when the flow of blood through the heart and lungs is completely stopped by clamping the pulmonary artery. The method consists of the continuous withdrawal of blood from a peripheral vein, the introduction of oxygen into the blood, and the continuous return of the oxygenated blood to the animal's arterial system through a peripheral artery.

2. The essential features of the apparatus are a pump to withdraw the venous blood, a revolving cylinder on the sides of which the blood is oxygenated, and another pump to inject the blood into the animal's artery.

3. The difference between this method and those used for the perfusion of isolated organs lies in the added technical difficulties entailed in the use of small peripheral vessels for the perfusion. The vessels must be of such small size that their ligation does not result in any impairment of nutrition or function of the tissues supplied by them. The use of such peripheral vessels permits the animal's heart and lungs to resume their normal functions again after removal of the clamp from the

pulmonary artery and the cessation of the extracorporeal circulation

4 Thirteen experiments are reported in which this method was employed. In these experiments the pulmonary artery was completely occluded for from 10 to 25 minutes, during which time life was maintained by an extracorporeal circulation. Five animals lived 24 to 48 hours after the experiment. Four animals lived from 8 to 23 days after the experiment. Finally, 4 animals lived from 1 to 9 months after periods of occlusion of the pulmonary artery of from 12 to 20 minutes. These 4 animals were normal in every respect and exhibited no neurological changes.

5 Control experiments performed under identical conditions with the exception that the extracorporeal circulation was not used have demonstrated irreparable neurological changes with periods of occlusion of the pulmonary artery of 4 minutes or longer and have also shown the impossibility of restoring life after a 10 minute period of occlusion of the pulmonary artery.

REFERENCES

- 1 BECK C S. Coronary sclerosis and angina pectoris. Treatment by grafting new blood supply upon myocardium. *Surg Gynec & Obst* 1933 64 270.
- 2 BECK C S and GRISHOLD R A. Pericardiectomy in the treatment of the pick syndrome. *Arch Surg* 1930 21 1064.
- 3 BECK C S and TERRY A L. Production of collateral circulation to heart. Experimental study. *Am Heart J* 1935 10 849.
- 4 CHURCHILL E D. Decortication of the heart (Delorme) for adhesive pericarditis. *Arch Surg* 1919 19 1457.
- 5 CUTLER E C and BECK C S. The present status of the surgical procedures in chronic valvular disease of the heart. *Arch Surg* 1919 18 403.
- 6 DALF H H and SCHUSTER E H J. Double perfusion pump. *J Physiol* 1928 64 356.
- 7 DEBAKEY M E. Simple continuous flow blood transfusion instrument. *New Orleans M & S J* 1934 87 386.
- 8 ELLIS D C. The diagnosis and treatment of wounds of the heart. A review of 22 cases. *J Am M Ass* 1938 111 1750.
- 9 GIMBOV J H Jr. Artificial maintenance of circulation during experimental occlusion of pulmonary artery. *Arch Surg* 1937 34 1103.
- 10 Idem. An oxygenator with a large surface volume ratio. *J Lab & Clin Med* 1930 24 2192.
- 11 GIMBOV J H Jr and CHURCHILL E D. The mechanical influence of the pericardium upon cardiac function. *J Clin Invest* 1931 10 405.
- 12 GESELL R A. On the relations of pulse pressure to renal secretion. *Am J Physiol* 1913 32 70.
- 13 HOOKER D R. A study of the isolated kidney. The influence of pulse pressure upon renal function. *Am J Physiol* 1910 27 24.
- 14 KASER W J. An experimental study of the effects of constriction of the great vessels of the heart. *Gynec & Obst* 1935 61 765.
- 15 KROLL H and SCHURCH O. Blood transfusion with heparin. *Lancet* 1938 1 2387.
- 16 MORITZ A R and BECK C S. Production of collateral circulation to heart. Pathological anatomical study. *Am Heart J* 1935 10 874.
- 17 MURRAY D W G and BECK C S. Heparin and thrombosis. *J Am M Ass* 1938 110 115.
- 18 NEMETZ D B. Personal communication.
- 19 REIN L. Die Chirurgie des Herzens und des Herzbeutels. *Berlin klin Wchnschr* 1913 50 247.
- 20 SCHWEDEN A. The technique of cardioplegia. *Surg Gynec & Obst* 1926 43 89.

THIRTY-THREE PREGNANCIES IN DIABETIC WOMEN

WILLIAM F MENGERT, M D, and KENNETH A LAUGHLIN, M D,
Iowa City, Iowa

THE association of diabetes and pregnancy is relatively infrequent, and there is a striking lack of agreement concerning the proper treatment of the diabetic woman who becomes pregnant. An additional series of patients, managed conservatively, is reported.

During the 12 year period, July 1, 1926, to June 30, 1938, 33 babies were born to 28 diabetic mothers among a total of 9,105 delivered women, an incidence of 1:270. This figure is three times greater than that reported by Kramer and by Potter and Adair and probably is biased because selected patients are received from a large geographic area. The majority of these patients were observed only during the last month of pregnancy, but in several instances it was possible to follow the individual throughout gestation. Their ages ranged from 17 to 43 years. There were 5 nulliparae, each of the 23 remaining women having been pregnant at least once, and 11, six or more times.

The diabetes was considered "severe" when the daily insulin requirement was 25 or more units, and "mild" when it was less than 25. According to this criterion, the classification of the diabetes depended upon whether the woman was pregnant or had been delivered. Prior to delivery 21 women had "severe" and 12 "mild" diabetes. Postpartum, only 14 women could be classed as "severe" diabetics. Three women were observed in 2, and one woman in 3 pregnancies. Two of the 3 women required more insulin during the second than during the first pregnancy and puerperium. The insulin requirement of the 2 other women was extremely labile.

CLINICAL FEATURES

Antepartum. In general, the antepartum courses were not marked by untoward manifestations. Two patients suffered from dia-

betic coma before term, both were delivered of living children. One of these patients had severe diabetes mellitus associated with diabetes insipidus. This combination of pregnancy, diabetes mellitus and insipidus, represents the only recorded case of the kind (Greene and Gibson). The baby succumbed from proved intracranial hemorrhage 48 hours after a low forceps delivery at term. Another patient, whose daily antepartum insulin dosage averaged 100 units, had numerous hypoglycemic reactions during pregnancy but was delivered of a living child. One patient developed gangrene of the third finger of the right hand following a traumatic fracture during the sixth lunar month of pregnancy. Amputation a few weeks later resulted in complete recovery, and a live baby was born at term. Another patient developed hydramnios—2000 cubic centimeters of amniotic fluid measured at delivery—but the baby, weighing 4,300 grams at birth, survived. Eight pregnancies were further complicated by non-convulsive toxemia, an incidence of approximately 24 per cent, which is definitely higher than the incidence (8.6 per cent) for the entire obstetric service during 1937. This finding agrees with the recorded experiences of White, Herrick and Tillman, Potter and Adair, and Joslin. There was no case of eclampsia among the diabetic patients.

One patient suffered with severe antepartum pyelitis but was delivered of a living child. Another patient experienced a few days of mild fever because of an upper respiratory infection. There was no other febrile reaction observed during the antepartum period. There were several incidental complications, such as arthritis, varicosities, hernia, scabies, gonorrhea, and yeast vaginitis.

No abortion occurred in any patient during her period of observation. In order to realize a more representative picture of abortion the entire reproductive careers of the 28 women were analyzed. Before the diabetes was recog-

nized, there were 84 pregnancies, resulting in 15 abortions (17.9 per cent), 10 term and premature stillbirths (11.9 per cent), and 59 surviving children (70.2 per cent), whereas after the known appearance of the disease there were 39 pregnancies, with 11 abortions (28.2 per cent), 16 stillbirths (41.0 per cent), and 12 surviving children (30.8 per cent). The probable explanation for the comparative absence of antepartum complications, such as acidosis and coma hypoglycemic shock, fever, and abortion, reported by many authors (1, 3, 4, 5, 6, 11, 12, 13) lies in the fact that most of the patients first came under observation late in pregnancy.

Labor. There were 28 spontaneous deliveries, 2 breech extractions, 2 outlet forceps operations and 1 cesarean section. All operative deliveries were performed because of obstetric indications.

Postpartum. There was no maternal death. In 5 patients or 15.3 per cent the postpartum temperature rose to 100.4 degrees F or above, but in only 1 instance, or 3 per cent, a low forceps delivery, did the fever persist for more than 24 hours.

The observations on this series of patients add relatively little toward solution of the old problem concerning the functional activity of the fetal pancreas in maternal diabetes. The postpartum maternal insulin requirement remained identical or was decreased in 24 and increased in only 9 patients. Of these 9 women none fed her baby wholly by breast. Two, or 22 per cent fed them by a combination of breast and formula whereas 7, or 78 per cent did not lactate beyond the first few puerperal days. Of the 14 women with identical or decreased puerperal insulin requirement, 15 or 63 per cent fed their babies wholly or partially by breast, whereas 9 or 37 per cent did not lactate beyond the first few days. These figures do little more than suggest that the elimination of sugar in the breast milk may serve to decrease the maternal puerperal insulin requirement. Although certain authors (1, 4, 5, 13) state that lactation in the diabetic woman is inadequate 17 of the 27 surviving babies were wholly or partially breast fed.

Babies. Twenty seven, or 81.3 per cent, of the babies survived. Four of the 6, non

surviving babies were stillborn and 3 were macerated. The non macerated stillborn baby weighed 1,750 grams. The birth weights of the three macerated babies were 4,845, 3,915, and 2,675 grams. One baby, weighing 2,510 grams, died 24 hours after birth presumably from hypoglycemia although no blood sugar determination is recorded. No autopsy was permitted. The sixth fatality involved a 3,830 gram baby who died 48 hours after a low forceps operation terminating a labor lasting 2 hours and 50 minutes. Sufficient intracranial hemorrhage to cause death was revealed at autopsy. Hypoglycemia was suspected in only 1 of the surviving babies, 3 hours after birth the blood sugar of 1 was 27 milligrams per cent. Fifty cubic centimeters of 5 per cent dextrose solution were injected subcutaneously with prompt relief. The other child was given glucose intramuscularly on the delivery table, did not nurse well for the first few days and 3 days after delivery was found to have a blood sugar of 30 milligrams per cent. Following further administration of glucose it recovered. The comparative absence of hypoglycemic reactions in the newborn child is probably explained by the fact that blood sugar estimations were not done routinely. Hypoglycemia is admittedly a potent danger in children of diabetic mothers and recognition of its appearance is essential.

The birth weights of the 34 babies averaged 3,551 grams, and ranged from 1,750 to 4,845 grams. Labor was induced in only 11 cases. There were no congenital anomalies, none of the surviving babies was febrile and all of them appeared to have normal vitality.

INDICATIONS FOR OBSTETRIC OPERATIONS

These patients were managed conservatively and concern was directed toward the diabetes rather than toward the pregnancy. A controlled diabetic who becomes pregnant is obstetrically speaking a normal woman. With this principle as a guide none of the patients was subjected to induction of labor or to operative intervention merely because she was diabetic. The usual rules of conservative obstetrics were followed and interference was instituted only for obstetric reasons accepted in the non diabetic.

The choice of the method of delivery has received much comment from many authors and cesarean section prior to term is enjoying increasing favor (5, 10, 11, 13). When done on the diabetic pregnant woman the indication must be viewed as *fetal* and not as maternal. Generally speaking, the advocates of abdominal delivery are in agreement with this view. Priscilla White is especially emphatic in her belief that cesarean section is indicated, and says, "Prevention of the death and decay of the over ripe fetus of the diabetic mother is a challenge today to the obstetrician and research worker in the field of diabetes. Premature delivery of the fully developed though chronologically premature infant of the diabetic mother by cesarean section is the obstetrician's successful answer to the challenge." In her series of 66 personally observed patients, there was a fetal salvage of 89.0 per cent, which may be compared with the fetal survival rate, 81.8 per cent, of the present series of patients under conservative management. Assuming, for the sake of argument, the 4 stillborn babies in this series might have been saved by abdominal delivery, although one of them weighed but 1,750 grams, 32 otherwise unindicated cesarean sections would have been necessary. This seems a prohibitive price to pay for 4 babies, especially after Plass (7, 8) and others have repeatedly called attention to the fact that cesarean section does not in itself conserve fetal life. On the contrary, the fetal mortality rate from cesarean section alone ranges between 8 and 16 per cent.

CONCLUSIONS

Thirty three pregnancies occurring among 28 diabetic women have been observed during

a 12 year period. The incidence of pregnancy and diabetes was 1:276 obstetric patients.

Obstetric operations were done only when indicated and not because of the diabetes. There were no maternal deaths and only one woman developed a fever which persisted more than 24 hours.

Twenty seven, or 81.8 per cent, of the babies survived.

Although the series is numerically small, the figures demonstrate that good results can be obtained by the conservative management of the pregnant, diabetic woman.

BIBLIOGRAPHY

1. BECKMAN H. F. Diabetes in pregnancy. *J. Indiana M. Ass.* 1936 39: 23.
2. CREENE JAMES A. and GIBSON R. B. Coexistence of diabetes mellitus and diabetes insipidus: report of a case with pregnancy. *J. Lab. & Clin. Med.* 1939 4: 455.
3. HERRICK W. W. and TILMAN, ALVIN J. B. Diabetes and pregnancy. *Surg. Gynec. & Obst.* 1938 66: 37.
4. HURWITZ, DAVID and IRVING FREDERICK C. Diabetes and pregnancy. *Am. J. M. Sc.* 1937 194: 85.
5. JOSLIN, ELLIOTT. *The Treatment of Diabetes Mellitus*. Philadelphia: Lea & Febiger, 1917.
6. KRAMER DAVID W. Diabetes and pregnancy. *Pennsylvania M. J.* 1936 39: 702.
7. PLASS E. D. The relation of forceps and cesarean section to maternal and infant morbidity and mortality. *Am. J. Obst. & Gynec.* 1931 22: 176.
8. Idem. A statistical study of 129,539 births in Iowa with special reference to the method of delivery and the stillbirth rate. *Am. J. Obst. & Gynec.* 1934 8: 93.
9. POTTER EDITH L. and ADAIR FRED L. Fetal and maternal mortality in diabetes. *Am. J. Obst. & Gynec.* 1938 35: 256.
10. RANDALL LAWRENCE M. and RYNARSON EDWARD H. Delivery and care of the newborn infant of the diabetic mother. *J. Am. M. Ass.* 1936 107: 919.
11. ROYSHAM JOSHUA. Diabetes and pregnancy. *Am. J. Obst. & Gynec.* 1933 25: 710.
12. SKIPPER ERIC. Diabetes mellitus and pregnancy. *Quart. J. Med.* 1933 2: 353.
13. WHITE PRISCILLA. Pregnancy complicating diabetes. *Surg. Gynec. & Obst.* 1935, 61: 324.

CONGENITAL BOWING AND PSEUDARTHROSIS OF THE LOWER LEG

Manifestations of von Recklinghausen's Neurofibromatosis

C GLENN BARBER M A M D Cleveland Ohio

PSEUDARTHROSIS following fracture or osteoclasia during childhood in congenital bowing of the lower leg has been observed frequently (3). Scoliosis (1, 8, 10, 11) and excessive growth in length of long bones (5, 6, 7, 9) have received particular attention although no mention of them has been made in standard texts on orthopedic surgery or scoliosis. The association of pseudarthrosis and congenital bowing of the lower leg with von Recklinghausen's neurofibromatosis which forms the theme of this article, seems thus far to have escaped notice in the literature of this country as well as that of Great Britain.

CASE HISTORIES

CASE 1. In February 1930 M G, an Italian girl aged 2 months, was brought to the Charity Hospital Dispensary because of a deformity present since birth of her right lower leg (Fig. 1). The leg was acutely bowed anterolaterally, angle opened backward in its lower third. In addition to the bowing there was considerable internal torsion. There was no history of trauma during or following birth and except for a number of small areas of dark brown pigmentation scattered over her body (Fig. 2) she appeared quite normal. These areas of pigmentation were of interest because the mother (Figs. 3 and 4) who accompanied the child was literally covered with neurofibroma molluscum. The mother expressed indifference to these brown spots on the child because she said that each of her 5 sons and one of her surviving daughters showed more spots than the patient and had never suffered any ill thereby. One daughter aged 11 years was free from these spots. In this family there had been 3 other children, prematurely born, whose sex had not been noted.

CASE 2. A brother T G, had sustained a fracture of his left lower tibia and fibula in June 1927 when he was 15 years old. This went untreated for 8 days and was then cared for by the family physician for 10 months during which period 5 operations were performed in attempts to get the bones to heal. On

March 21, 1928, this brother was seen in the fracture clinic and referred to the orthopedic service. His left lower leg was somewhat swollen, red and presented two discharging sinuses. There was non-union of the bones of the lower third of his leg. Flexion contracture of 80 to 90 degrees was present in the left knee. Roentgenograms since destroyed showed two small sequestra. On March 21, 1928, sequestrectomy and curettage were performed. Healing of the bones and operative wound was not complete until June 29, 1929. Good function with out symptoms continues to the present time.

A notation on the house record of this boy calls attention to a deformity present since birth of the left side of his chest and also to a flabby, dull brownish colored tumor present in the usual position of the left nipple. The significance of these facts is now evident.

M G (Case 1) had been brought to the clinic to have the deformity of her leg corrected. Her family felt that some sort of operation should be done. Operative intervention seemed inadvisable for the following reasons. There was at that time under our care a child (M M) on whom several unsuccessful operative attempts, the last one by myself, had been made to obtain union in the lower tibia and fibula which osteotomy for correction of anterior bow leg had been performed in 1922. Two other instances of pseudarthrosis of the lower leg following osteotomy in non-rachitic children remained vivid in my memory. A review of the literature at the time offered no helpful suggestion on the course of treatment to be followed. Consequently M G's family was persuaded to see what improvement might be obtained by daily manipulation.

On June 23, 1930, the patient was beginning to walk. When seen again on September 6, 1930, a tracing of the deformity compared with one made 5 months previously showed some improvement in the degree of curvature. Roentgenograms made on September 8, 1930 (Fig. 5) show the extent of the deformity then present. On October 22, 1931, the patient was walking well, the deformity was unchanged. She was not seen again until August 2, 1932, when the family was advised that operation for correction of the existing deformity should not be attempted until after adolescence.

The tendering of this advice was the consequence of hearing a paper on June 17, 1932

From the Departments of Anatomy and Surgery (Orthopedic Service) Western Reserve University and the University Hospitals

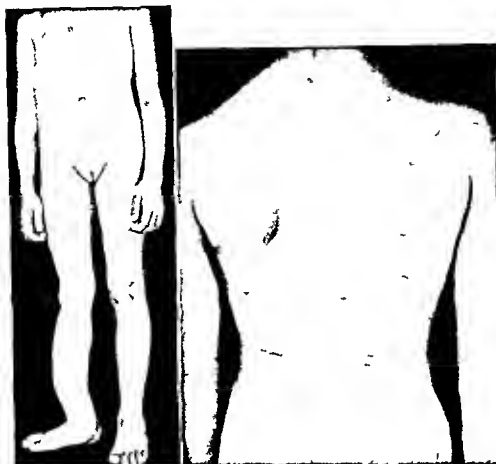


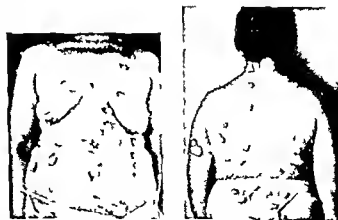
Fig 1, left Photograph of M G showing present lower leg deformity
 Fig 2 Photograph of M G showing pigmented skin areas associated with von Recklinghausen's disease

by Dr Wallace Cole, at the meeting of the American Orthopedic Association, in Toronto, entitled "Congenital Non union of the Tibia." Cole pointed out that even though bony union may occur early and seem quite firm and adequate physically as well as roentgenographically for a considerable period of time following osteotomy or fracture during childhood in congenital bowing of the lower leg, pseudarthrosis may later develop for no apparent reason. After adolescence operative correction was more successful for deformity and non union (2).

Figures 6 and 7 show the degree of deformity recorded by roentgenograms made on February 6 1934, and Figure 8 shows the condition on July 5 1938. Figures 1, 2 and 8 illustrate the deformity and the associated pigmented skin areas as they now appear. In addition to the bowing the right leg is approximately $\frac{1}{2}$ inch shorter than the left. No apparent functional handicap exists, and although the end result here obtained fails to meet orthopedic

ideals, it far surpasses the end results obtained in the 3 cases which follow.

CASE 3 M M, an Italian girl was admitted to the orthopedic department on November 16 1922 when she was 2 years old because of a deformity present since birth, of her left lower leg. Her father,



Figs 3 and 4 Photographs of front and back of M G's mother. Degree and extent of neurofibroma molluscum have not changed since M G was first seen in 1930.



Fig 5

Fig 6

Fig 7

Fig 8

Fig 5. Roentgenogram of MC to show condition of deformity as it appeared on September 8, 1930 at the age of 9 months.

Figs 6 and 7. Roentgenograms of MC to show condition of deformity of both legs on February 6, 1934 at the age of 3 years 2 months.

Fig 8. Roentgenogram of MC to show condition of deformity on July 5, 1938 at the age of 8 years 7 months.

mother and 6 siblings were living and well. The patient had been breast fed for 15 months, began walking at 20 months and except for an occasional cold and some stomach trouble had been well.

Examination showed a marked anterolateral bowing of the left leg in its lower third. Physical examination and roentgenograms of knees and wrists showed no evidence of rickets.

On November 17, 1922, osteotomy of the left tibia and fibula at the site of the deformity was performed and a plaster cast applied. Postoperative roentgenograms showed the deformity to be well corrected with the fragments in good position and alignment. On January 2, 1923, the plaster cast was removed; the operative wound was well healed; bony union was quite firm and the deformity had apparently been corrected. A short walking plaster was therefore applied. Three weeks later the foot and lower leg were in good position; bony union was firm and the deformity remained corrected. Massage to the foot and lower leg was prescribed twice daily and the patient began walking in 2 weeks.

On July 7, 1923, when she was next seen, the deformity had begun to recur and a brace was applied. By February 5, 1924, the deformity had recurred and she was admitted to the hospital for operation. The ends of the bones were freshened and a new plaster cast applied. On May 21, 1924, she was readmitted to the hospital because the deformity had increased. The following day resection of an ununited fracture of the left lower leg was performed. Fibrous tissue was removed and the laterally overriding fragments of bone ends chiseled away. Fair approximation of the ends was obtained. On June 19, 1924, the patient was discharged from the hospital wearing a plaster cast.

In spite of physical and roentgenological evidence of favorable progress for a time and the continuous application of supportive apparatus for 3 years and 2 months, pseudarthrosis with deformity again developed. On July 18, 1927, open reduction of the left tibia was performed. The ends of the tibia were removed and the stumps tied in apposition with chromic catgut passed through drill holes. On August 12, the wound was clean and entirely healed.

On September 27, the patient began to walk with the cast still on the leg. On December 10, the cast was removed. There was still some motion of the fragments though the position was good. A new cast was applied. On May 19, 1928, a brace was applied. On August 10, 1929, the patient was walking with a short brace. There was non-union in the lower third of her leg. The distal fragment was pointing laterally and posteriorly. On September 22, 1930, the following x-ray report was made: Left tibia and fibula show old ununited fracture of tibia about 3 inches above the ankle with fragments in apposition but with marked outward and posterior angulation. There was spiral bowing of fibula at the same level with no evidence of fracture.

On August 27, 1931, a massive bone onlay graft, the last operative attempt to obtain bony union, was performed. The area of pseudarthrosis was exposed and just enough of the bone ends resected to permit correction of the deformity. Two full thickness grafts obtained from the right tibia were placed in longitudinal grooves extending well beyond the fracture line of both tibial fragments. The grafts placed on opposite sides of the tibia were secured by 4 chromic catgut ties encircling them and the bone fragments. Bone chips obtained in making the grooves were placed alongside the grafts.



Fig 9



Fig 10



Fig 11

Fig 9 Photograph showing deformity of M M's leg with operative wounds. Scar over right tibia shows site where tibial graft was removed.

Fig 10 Roentgenogram of both of M M's legs. Right tibia and fibula show good mineralization. Note scars of interrupted growth in lower tibia. Left tibia shows osteo-

porosis with greater demineralization at lower ends which show the scars of interrupted growth. Sclerotic bone surfaces at the site of osteotomy and retarded growth in all dimensions.

Fig 11 Photograph of M M showing café au lait spots characteristic of von Recklinghausen's disease.

On August 29, 1931, a roentgenogram showed that the grafts were holding the bones in good position and alignment. On September 19, a roentgenogram showed the graft and fragments in good position but there was still no callus. On September 30, a roentgenogram showed that the graft and fragments were still in good position and there was now apparent some evidence of callus. Reapplication of casts at regular intervals continued until March 29, 1932.

The patient did not report to the clinic as directed and was not seen again until August 23, at which time bony union was still lacking. She has been seen occasionally during the past 6 years. Figures 9 and 10 show the condition of her leg at the present time. The left leg now measures $27\frac{1}{2}$ inches, the right 30 inches. For the past $2\frac{1}{2}$ years she has preferred to hobble about without any supporting appliance. Permission for further operative intervention has been refused.

Figure 11 shows the pigmented skin areas of chest and abdomen. These areas are present to a lesser degree in other parts of the body. The area beneath the left nipple is very deeply pigmented. The shadow at the umbilicus is intensified by brown pigmentation extending to its depths and somewhat irregularly beyond its borders.

The only other member of the family allowing examination was the father who has a number of small pigmented skin spots scattered irregularly over his body, a few of which are elevated from the surrounding surface, two of these spots are pedunculated. Several small round lumps can be felt in the skin but a diagnosis of von Recklinghausen's disease

here would be presumptuous. The mother likewise presented suggestive evidence of the disease. She refused examination but there were a few brownish nodules visible on her face and neck and a patch of pigmented skin about 2 to 4 centimeters in diameter was plainly visible through the stocking on her right lower leg.

For the patient herself, now well beyond the age of puberty, there is hope of successful bony union provided fixation of the 2 ends of the tibia is permitted.

CASE 4. A T (Figs 12, 13, 14 and 15) a Hungarian girl aged 14 years was born with a crooked right leg. Her mother died from uterine hemorrhage following an interrupted 3 months pregnancy when A T was 3 years old. Three sisters are living and well. The father (Figs 16 and 17), now 49 years of age, presents a typical picture of von Recklinghausen's neurofibromatosis, even to the frequently associated scoliosis.

A consultant recommended that A T's leg be straightened by an operation but that this should not be done until she was 3 or 4 months old. Osteotomy of the right lower leg was performed therefore at the age of 4 months, but both tibia and fibula failed to unite. The hospital record states that on admission the degree of atrophy and deformity indicated amputation. On January 24, 1927, the right lower leg was amputated.

Although a diagnosis of von Recklinghausen's disease was not stated in the hospital record, some of the skin lesions seen in the accompanying photographs were thus described: "On the anterior surface of the right shoulder is a raised red lesion about

Fig 12 Photograph of A T
Note pigmented skin areas on
shoulder abdomen and thigh
Figs 13 and 14 Photographs
of A T showing site of amputa-
tion typical café au lait spots
and neurofibroma molluscum
characteristic of von Reckling-
hausen's disease



Fig 12



Figs 13 above and 14



Fig 15 Roentgenogram of lumbar vertebral column
and pelvis of A T Note congenital anomalies of lower
lumbar and sacral region and associated scoliosis

the size of 4 half dollar present since birth. It is bright red slightly spongy and quite sharply defined. Two large pigmented naevi are seen on the right side of the abdomen and 3 or 4 small ones on the back. The left shoulder shows a small pea sized papule similar to that on the right shoulder. The abdomen shows many scattered dry pinhead sized red papules. The skin lesions as they now appear excepting color variations are well illustrated in Figures 13 and 14. Figure 15 shows congenital anomalies in the lumbar spine and sacrum and some structural change in bone and soft tissue.

CASE 5 H L¹ is a Bohemian girl now aged 8 years. Despite full term normal delivery and a birth weight of 7½ pounds she presented a congenital deformity in the lower third of the right leg (Figs 18, 19, 20 and 21). The mother, 2 sisters and 2 brothers are living and well. One brother born with a pyloric stenosis for which a successful operation was performed during the second or third week of his life died from osteomyelitis at 11½ months. Another child was born dead at 8½ months. The father is living but is somewhat disabled from a severe bronchitis.

There is no evidence of rickets in the patient's history. She began to walk at about the age of one year. At 18 months a fall to the floor while walking caused an injury to her deformed leg. The doctor to whom she was taken at the time found nothing more than a sprain so he strapped the leg with adhesive

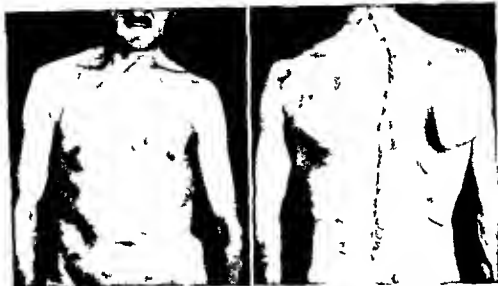


Fig 16 left Photograph of A T's father Neurofibroma mollusca and pigmented skin areas quite definite

Fig 17 Showing back of A T's father with typical café au lait spots and neurofibroma mollusca Note degree and extent of associated scoliosis frequently present in von Recklinghausen's neurofibromatosis

sive plaster For the following 3 or 4 months, during which time the father attempted to care for the leg by repeated adhesive strapping there was a gradually increasing deformity accompanied by pain, swelling, and disability

The child was then taken to Dr T A Willis who found an ununited fracture at the site of the injury A plaster cast was applied and with renewals at regular intervals was worn for 2½ years without benefit On August 19, 1934 when the patient was 4 years old a bone graft operation was performed Casts and braces have been worn continuously since that date

Figure 22 shows the roentgenographic appearance of her leg 2 days before operation and Figure 23, 3 days after operation In Figure 24 a roentgenogram made 1 year and 4 months after operation, union of the tibia is still wanting although the fibula has united An interval of 2 years and 6 days elapsed from the time this roentgenogram was made until the most recent one (Fig 25) was obtained This shows that firm bony union is now present in the tibia as well as in the fibula Manual examination and also the ability of the leg to withstand the entire body weight are further proofs of bony union Because of the marked angulation and the degree of sclerosis present in the tibia however, supportive apparatus for weight bearing is being continued

The association of congenital bow leg, pseudarthrosis, and von Recklinghausen's disease has heretofore escaped attention but in the cases just presented the association is unequivocal In the 4 girls bowing of the lower leg was present at birth Pseudarthrosis followed fracture in one, osteoclasia in another

and osteotomy in a third In one girl, Case 1, fracture and operative intervention have thus far been avoided In the single male, F G, brother of M G, Case 1, definite evidence of deformity prior to fracture is wanting

In the one family, the mother (Figs 3 and 4) and 7 of 8 surviving siblings present typical lesions of the disease In another family, the father (Figs 16 and 17) shows external lesions in addition to the frequently associated scoliosis

The evidence thus far advanced, though quite definite, might rightly be questioned as being conclusive for the thesis here proposed The addition of these 5 cases to the 1 atypical and 9 typical cases already reported by Robert Duroquet should dispel any doubt Thirteen of 15 cases disclose a definite and identical etiology which is convincing even for a rare disease The following is a brief review of Duroquet's cases

Pen, 10 years We have no information on the father The mother recalls a birth injury having provoked fracture The child shows all the signs of a definite fibrous pseudarthrosis She is covered with pigmented spots—"café au lait" We have attended this child for 3 years The bones of the limbs have developed though union has never occurred

Ben, 14 years The mother who refuses to be examined attributes the fracture, which did not unite, to obstetrical traumatism The child has a



Fig 18 left H.L. at 7 years with brace

Fig 19 H.L. without brace

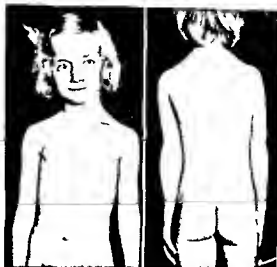


Fig 20 left Front view of H.L. to show pigmented areas on trunk

Fig 21 Back view of H.L. to show pigmented areas

Scoliosis functional

typical pseudarthrosis with fusion of fibula to tibia. He has been operated on 6 times one operation being a perilemoral sympathectomy. He is covered with cast au lait pots. He has never walked without support.

Case 65 years. Heredity unknown but his father had the same affliction a pseudarthrosis which dated from birth at which time he had a broken leg. Patient presents a typical pseudarthrosis. He was not operated upon. A diagnosis of typical von Recklinghausen's disease was made. Patient was covered



Fig 22

Fig 23

Fig 22 Roentgenogram of H.L.'s right leg August 1935 showing deformity and non union of tibia

Fig 23 Roentgenogram August 24 1935 of right leg after operation



Fig 24

Fig 25

Fig 24 Roentgenogram December 11 1936 of right leg to show condition 16 months after operation

Fig 25 Roentgenogram December 17 1938 of right leg to show present condition

with pigmented areas and had cutaneous tumors, showing numerous neuromas

A 4½ years Mother who was covered with multiple spots refused to be photographed Birth was normal Mother thinks that a fracture originated then and never healed There is typical tibia fibula fusion Patient's body is covered with pigmented spots

Br 3 years No family history is given He shows definite pigmented areas in the skin and malformation of the left tibia

Bernard 4½ years Body is completely pigmented The mother is 35½ years old He presents a typical neurofibromatosis

Mer, 12 years The mother presents numerous spots He has a congenital deformity of the tibia and multiple café au lait spots are noted The mother thinks the deformation is increasing At examination, the deformation showed an angle open behind X ray film shows posterior thickened area

Tardi, 5 years The mother presents certain café au lait spots Definite deformation from birth has been present in both tibiae which has been growing worse Osteotomy has been suggested The two tibiae are much curved inward and open behind there is a polycystic condition in the area of deformation X ray films taken after 2 years show the condition slightly worse

Thon, 37 years There is present a congenital bowing of the leg with great shortening (20 centimeters) Delayed labor is noted in history Isolated spots are present on the atrophied limb X ray films show shortening with a bowing of the tibia forward

Cro 2 years Patient was born with a tibial deformity Examination shows congenital pseudarthrosis in both bones of the leg confirmed by the x ray The body of this infant is covered with spots which seem to be becoming darker

Div We cite, to recall it, the only case in which we have not been able to obtain any cutaneous evidence, pigmentary, or any growth associated with this congenital tibial lesion

In these observations we see that among 7 patients a pseudarthrosis occurs in 5 and in 1 a congenital bending One other patient showing congenital bending has a mother who suffers from von Recklinghausen's disease Finally, in the last case of bending we find the marks both in the child and in the mother Because of the same family history, it appeared logical to M Duroquet to combine these tibial deformities with pseudarthrosis

A tibia which is congenitally deformed or bent or shows a pseudarthrosis may be a suspicious indication of von Recklinghausen's disease This association has appeared so consistently that M Duroquet believes it possi-

ble that in the isolated instances where neurofibromatosis is not definitely mentioned, it would be possible, nevertheless, to find manifestations of von Recklinghausen's disease within the third or fourth generations

The hereditary nature of von Recklinghausen's disease has been known for a long time but M Duroquet has verified it and brought new observations There is one family in which the grandmother, the mother and the daughter had all 3 signs, namely, bowed tibia, café au lait spots, and neurofibromatosis with accompanying scoliosis In another instance the daughter showed isolated spots and scoliosis, and the mother presented the complete manifestations of cutaneous tumors, neuromas, and pigmentation

SUMMARY AND CONCLUSIONS

Added to M Duroquet's cases are 5 cases in 4 of which definite bending of the lower leg is known to have been present at birth In one case, that of M G, fracture and operative intervention have been avoided and no functional handicap exists In this case some improvement in the degree of angulation has taken place with growth Osteotomy, osteoclasia, and fracture were each followed by pseudarthrosis in 3 cases Pseudarthrosis followed fracture in the 1 case in which no history of bending could be obtained

All of the cases here reported show typical lesions of von Recklinghausen's disease In the one family in which congenital bowing occurred in one girl and pseudarthrosis following fracture in a brother, 7 of 8 surviving siblings show typical skin lesions and the mother is literally covered with neurofibroma molluscum

In one child on whom osteoclasia was performed for the correction of bow leg, deformity and disability necessitating amputation followed In addition to the typical skin lesions this child also presents congenital anomalies of her lumbar spine including a scoliosis Her father shows the widely scattered skin lesions of von Recklinghausen's disease and the frequently associated scoliosis

Röntgenograms of the long bones, skull, and pelvis show no cysts in either the children or parents so examined

The association of pseudarthrosis with congenital bowing of the lower leg in childhood has been recognized and accepted by a few orthopedic surgeons, though published references of actual cases do not appear in the literature of this country

The association of congenital bow leg pseudarthrosis and von Recklinghausen's neurofibromatosis has heretofore not been recognized, but that such an association does exist cannot be disputed on the findings of the cases here presented

Associated cystic bone changes seldom accompany the condition. In only one case that of Ducroquet's (Farlt) there is in the area of deformation a polycystic condition

REFERENCES

1 BROOKS BARNEY and LEHMAN EDWIN I. The bone changes in Recklinghausen's neurofibromatosis Surg Gynec & Obst 1924 38 587

2 COLE, WALLACE H. Congenital bowing and nonunion of the lower leg. Read at the meeting of the American Orthopedic Association in Toronto on June 17 1932 (Paper never published)

3 Idem. Personal communication 1938

4 DUCROQUET ROBERT. Apropos des pseudarthroses et inflexions congénitales du tibia. Mém Acad de chir 1937 63 863

5 GOULD FRIC I. The bone changes occurring in von Recklinghausen's disease. Quart J Med 1918 11 221

6 HARBITZ FRANCIS. Multiple neurofibromatosis (von Recklinghausen's disease) bone changes. Arch Int Med 1909 13 32

7 LE BELL IRVING C. Von Recklinghausen's neurofibromatosis in children. Arch Pediat 1937 54 454

8 LEHMAN EDWIN P. Recklinghausen's neurofibromatosis and the skeleton. Arch Dermat & Syph 1926 14 178

9 MILLER ALEXANDER. Neurofibromatosis with reference to skeletal changes: compression myelitis and malignant degeneration. Arch Surg 1936 32 109

10 WILBER F PARKES. Cutaneous pigmentation as an incomplete form of von Recklinghausen's disease etc. Brit J Dermat 1903 21 49

11 WATSON RICHARD S. Curvature of spine in von Recklinghausen's disease. Arch Dermat & Syph 1921 3 144.

The association of pseudarthrosis with congenital bowing of the lower leg in childhood has been recognized and accepted by a few orthopedic surgeons though published references of actual cases do not appear in the literature of this country.

The association of congenital bow leg pseudarthrosis and von Recklinghausen's neurofibromatosis has heretofore not been recognized but that such an association does exist cannot be disputed on the findings of the cases here presented.

Associated cystic bone changes seldom accompany the condition. In only one case that of Ducroquet's (Tarlet) there is in the area of deformation a polycystic condition.

REFERENCES

1. BROOKS BARNEY and LEHMAN EDWIN I. The bone changes in Recklinghausen's neurofibromatosis. *Surg. Gynec. & Obst.* 1924 38 587.
2. COLE WALLACE H. Congenital bowing and nonunion of the lower leg. Read at the meeting of the American Orthopedic Association in Toronto on June 1, 1932. (Paper never published.)
3. Idem. Personal communication 1938.
4. DUCROQUET ROBERT. A propos des pseudarthroses et inflexions congénitales du tibia. *Mém. Acad. de chir.* 1937 63 863.
5. GOULD LEROI. The bone changes occurring in von Recklinghausen's disease. *Quart. J. Med.* 1918 11 221.
6. HARBITZ FRANCIS. Multiple neurofibromatosis (von Recklinghausen's disease) bone changes. *Arch. Int. Med.* 1909 3 32.
7. LE BELL IRVING C. Von Recklinghausen's neurofibromatosis in children. *Arch. Pediat.* 1937 54 434.
8. LEHMAN EDWIN P. Recklinghausen's neurofibromatosis and the skeleton. *Arch. Dermat. & Syph.* 1926 14 178.
9. MILLER ALEXANDER. Neurofibromatosis with reference to skeletal changes, compression myelitis and malignant degeneration. *Arch. Surg.* 1936 32 109.
10. WEBER F. PARKES. Cutaneous pigmentation as an incomplete form of von Recklinghausen's disease etc. *Brit. J. Dermat.* 1909 21 49.
11. WEISS RICHARD S. Curvature of spine in von Recklinghausen's disease. *Arch. Dermat. & Syph.* 1921 3 144.

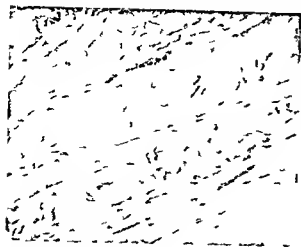


Fig 1 Normal fascial covering—one layer of mesothelial cell



Fig 2 High power of mesothelial cells

Figures 1 and 2 and in its simple form is a single layer of flattened cells

It must be remembered that these tissues are of much smaller and more delicate arrangement than the synovial linings of larger cavities such as in osseous joints the peritoneum and thorax. Hence they are much more difficult to show histologically and their study must be closely correlated with their function. The origin of the cells lining these gliding joints is from the connective tissues as are other synovial membranes lining the

joints referred to. The function of the synovial membrane in all these locations is to permit this gliding or rotatory motion between adjacent tissues.

Hyperplasia of the mesothelial cells lining the fascial joints (Figs 3 and 4) may indicate a proliferative reinforcement in response to abnormal strain or to altered secretions from inflammation. This hyperplasia may interfere with normal nerve and blood vessel function without other clinical evidence of inflammatory reaction. With associated rheumatic

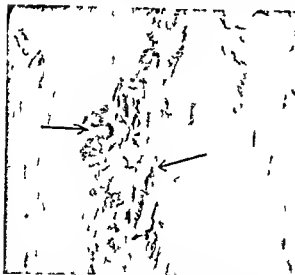


Fig 3 Case 1 plantar fascia. Hyperplasia of fascial mesothelium (lower power) and myosynovitis



Fig 4 High power of Figure 3. Note excrecences of mesothelium



Fig 8 Case 4 fascia lata Calcific deposits scattered through the fascia

In still other conditions—as lymphatic elephantiasis the abnormal strain on the fascia produces various types of degeneration as extravasations of lymph deposits of blood crystals and calcific deposits from ruptured capillaries and lymphatics.

Figure 8 from Case 4 shows calcific deposits scattered through fascia lata.

CASE 4 M F Female aged 28 referred for surgical treatment by Dr C Whitney Banks had a bilateral enlargement of thighs and both lower extremities of 14 years duration. A clinical diagnosis of lymphangiectatic elephantiasis was made. Fascia lata biopsy specimen was obtained at the time of modified Kondoleon operation October 17 1938. Incision from high on the left buttocks to beyond the left ankle. Living fascial sutures left attached at one end used to approximate partially the fascial surfaces before the skin was closed. Similar operative procedure on the right extremity and buttocks on October 27 1938. Follow up for over 10 months with a clinical and cosmetic result highly satisfactory to both the surgeon and the patient.

In cases of long continued trauma as in various occupations actual bony plates are formed in the fascia as shown in Figure 9 from Case 5.

CASE 5 Male aged 19 student was a strenuous athlete especially in baseball. He had a circum-



Fig 9 Case 5 fascia lata Bony plates in fascia

scribed area on the inner aspect of the thigh which had been present about a year. A clinical diagnosis of myositis interstitialis ossificans was made (Reported through the courtesy of Dr George Saspel).

As a result of the anatomical roentgenographic and biomechanical studies previously reported and confirmed by the histopathological studies mentioned we believe that fascial pathology often reveals the true cause of radicular muscular pain. It would seem that many cases not previously diagnosed may well be designated myosynovitis or fascial adhesions. Moreover, there is reason to believe that the temporary success in some of these cases by massage and manipulation may be explained by the freeing of agglutinated fascial surfaces, the releasing of secretions, or by breaking adhesions rather than by changing the anatomical position of osseous structures. The correlation of these studies tend to clarify the clinical management of patients suffering from pathological involvement of fascial planes.

In selected cases pneumofasciograms are used in an attempt to localize the pathology in addition to biomechanical measurements of the range of motion of the involved joints. These measures combined with very careful clinical study of the patients have been found of value in localizing the pathology. When operative procedures are indicated either on the fascial or osseous structures they are combined with the removal of biopsy specimens for pathological, and when possible, for biomechanical studies.



Fig. 8. Case 4. fascia lata. Calcific deposits scattered through the fascia.

In still other conditions—as lymphatic elephantiasis the abnormal strain on the fascia produces various types of degeneration as extravasations of lymph, deposits of blood crystals and calcific deposits from ruptured capillaries and lymphatics.

Figure 8 from Case 4 shows calcific deposits scattered through fascia lata.

CASE 4. M. F. Female aged 28 referred for surgical treatment by Dr. C. Whitney Banks had a bilateral enlargement of thighs and both lower extremities of 14 years' duration. A clinical diagnosis of lymphangiectatic elephantiasis was made. Fascia lata biopsy specimen was obtained at the time of modified Kondoleon operation October 17, 1938, incision from high on the left buttocks to beyond the left ankle. Living fascial sutures left attached at one end used to approximate partially the fascial surfaces before the skin was closed. Similar operative procedure on the right extremity and buttocks on October 27, 1938. Follow up for over 10 months with a clinical and cosmetic result highly satisfactory to both the surgeon and the patient.

In cases of long continued trauma as in various occupations actual bony plates are formed in the fascia as shown in Figure 9 from Case 5.

CASE 5. Male aged 19 student was a strenuous athlete especially in baseball. He had a circum-



Fig. 9. Case 5. fascia lata. Bony plate.

scribed area on the inner aspect of the thigh had been present about a year. A clinical diagnosis of myositis interstitialis ossificans was reported through the courtesy of Dr. C. Whitney Banks.

As a result of the anatomical, radiographic and biomechanical studies reported and confirmed by the histological studies mentioned we believe that fascial pathology often reveals the cause of radicular muscular pain. It is noted that many cases not previously known may well be designated myosinovascular adhesions. Moreover, there is no doubt that the temporary success in these cases by massage and manipulation may be explained by the freeing of fascial surfaces, the releasing of adhesions by breaking adhesions rather than by breaking the anatomical position of the muscles. The correlation of the anatomical studies to clarify the clinical management suffering from pathological involvement of fascial planes.

In selected cases pneumofasciotomy is used in an attempt to localize the pathology. In addition to biomechanical measures the range of motion of the involved muscles. These measures combined with very careful clinical study of the patients have been of value in localizing the pathology. The operative procedures are indicated when the fascial or osseous structures are involved combined with the removal of biopsy specimens for pathological and when possible biomechanical studies.

TABLE III — TOXIC MANIFESTATIONS

	Routine A	R. B.	R. C.	Un- treated	Per cent
M. L. J. J.	1	1	1	2	37.5
and vomiting	2	3	5	7	85
Diarrhea			2	3	6.8
Dr. med.					2.8
Drug fever			1	1	2.7
M. tal. act. na			4	2	8.5
M. L. J. J. J. J.	5	4	2	4	2.7
Uterine myoma		2			2

and intrapartum infection. After 42 hours of labor she was delivered by forceps of a 10 pound stillborn fetus. Temperature rose rapidly to 103 degrees. Sulfanilamide therapy was discontinued when only 60 grains had been given because of very marked cyanosis, hyperpnea and diarrhea. On the fourth day temperature rose to 103.4 degrees and the patient became comatose. Blood culture showed hemolytic streptococcus. Necropsy showed gangrene of the uterus with pelvic peritonitis.

R. D. colored primipara aged 22 years was admitted to the hospital on January 7, 1938, in shock with a diagnosis of incomplete abortion. The vagina was packed and the uterus was emptied later. Chill with a rise in temperature to 104.6 degrees followed promptly. She received 365 grains of sulfanilamide. Four blood cultures were negative. She died on the nineteenth day. Necropsy revealed septic endometritis with septic thrombophlebitis of both ovarian veins.

B. R. quadripara aged 28 years was admitted to the hospital on August 20, 1938, with a diagnosis of incomplete abortion, temperature 102.6 degrees and pelvic peritonitis. A few days later she bled profusely passed some tissue and the temperature fell to normal later spiking and associated with repeated chills. The uterus was not entered. Large doses of sulfanilamide totaling 1210 grains were given in 14 days. Several blood transfusions totaling 3,000 cc were given. Repeated blood cultures were positive for Streptococcus hemolyticus group C. Necropsy showed infected polypoid placental tissue, acute vegetative bacterial endocarditis and a rider's thrombus at the bifurcation of the aorta. This case will be reported in detail in a later communication.

In only one of these cases was sulfanilamide therapy adequate. In 4 cases it was discontinued for what was thought to be good reason, or not begun soon enough. Probably we can not expect a good therapeutic result from chemotherapy in the presence of pelvic abscess, pelvic thrombophlebitis, retained placental fragments, and bacterial endocarditis.

TOXIC MANIFESTATIONS—TABLE III

There were no deaths due to sulfanilamide therapy. In about half of our cases some toxic symptoms appeared, occurring more often and to greater degree in those receiving the higher dosage. However, no definite correlation between the amount of the drug and the occurrence or severity of the symptoms could be made. While less than 40 grains of sulfanilamide produced toxic symptoms in some cases in other instances more than 500 grains did not. Sulfanilamide was discontinued in 16 cases because of severe toxic manifestations.

Cyanosis possibly represents pigmentation and has nothing to do with the oxygen carrying power of the blood. First noticed in patchy blue areas about the cheeks and lips, it rapidly becomes generalized. We have seen it occur after 20 grains had been taken and occasionally diminish and even disappear though large doses of sulfanilamide were being given. As a rule it appeared on the second day of treatment, and persisted for 3 days after the drug had been discontinued. It may occasionally interfere with accurate determination of hemoglobin by the colorimetric method, and erythrocyte counts must be relied upon when other methods of estimation are not available.

We look upon nausea and vomiting as of gastro intestinal origin, though it may be cerebral. Diarrhea apparently not due to infection has been reported by Lockwood, Coburn and Stokinger. We have noted it in 8 cases.

Signs of cerebral irritation were dizziness 4 cases, headache 10 cases and drowsiness, semi stupor, disorientation, excitement or nervousness in 10 cases. In 3 of these cases feeding was difficult.

We have found it difficult to identify drug fever beyond question in more than 3 cases. There were 9 other cases in which it appeared likely. Six of these patients were receiving large doses of sulfanilamide. The diagnosis of drug fever was made, when after a long afebrile or low febrile period of 5 to 7 days the temperature rose without corroborative evidence of increased puerperal infection and the drug was stopped, fever abated in a day or two.

Slow anemias were common. In many cases leucocytosis diminished or disappeared during

TABLE III — TOXIC MANIFESTATIONS

	R u t n A	R I H	R t C	U n t a d d e z e d	P c t
M r k d y n o s	13	1	3	7	37.3
N u s e a n i v m u l t i g		3	3	2	8.5
D a b e				3	6.8
D r m a t u					1.8
D r u g f e			1	1	2.7
M e t l c t o n			4	2	8.5
M i t h m y l t c m u	5	4	2	4	2.2
A c u t h m y l t n m u					1.8

and intrapartum infection. After 42 hours of labor she was delivered by forceps of a 10 pound stillborn fetus. Temperature rose rapidly to 103 degrees. Sulfanilamide therapy was discontinued when only 60 grains had been given because of very marked cyanosis, hyperpnea and diarrhea. On the fourth day temperature rose to 105.4 degrees and the patient became comatose. Blood culture showed hemolytic streptococcus. Necropsy showed gangrene of the uterus with pelvic peritonitis.

R. D. colored primipara aged 22 years was admitted to the hospital on January 7, 1938, in shock with a diagnosis of incomplete abortion. The vagina was packed and the uterus was emptied later. Chill with a rise in temperature to 104.6 degrees followed promptly. She received 365 grains of sulfanilamide. Four blood cultures were negative. She died on the nineteenth day. Necropsy revealed septic endometritis with septic thrombophlebitis of both ovarian veins.

B. R. quadripara aged 28 years was admitted to the hospital on August 29, 1938, with a diagnosis of incomplete abortion, temperature 102.6 degrees and pelvic peritonitis. A few days later she bled profusely, passed some tissue and the temperature fell to normal later spiking and associated with repeated chills. The uterus was not entered. Large doses of sulfanilamide totaling 1210 grains were given in 14 days. Several blood transfusions totaling 3700 cc were given. Repeated blood cultures were positive for Streptococcus hemolyticus group C. Necropsy showed infected polypoid placental tissue, acute vegetative bacterial endocarditis and a riders thrombus at the bifurcation of the aorta. This case will be reported in detail in a later communication.

In only one of these cases was sulfanilamide therapy adequate. In 4 cases it was discontinued for what was thought to be good reason, or not begun soon enough. Probably we can not expect a good therapeutic result from chemotherapy in the presence of pelvic abscess, pelvic thrombophlebitis, retained placental fragments, and bacterial endocarditis.

TOXIC MANIFESTATIONS—TABLE III

There were no deaths due to sulfanilamide therapy. In about half of our cases some toxic symptoms appeared, occurring more often and to greater degree in those receiving the higher dosage. However, no definite correlation between the amount of the drug and the occurrence or severity of the symptoms could be made. While less than 40 grains of sulfanilamide produced toxic symptoms in some cases, in other instances more than 500 grains did not. Sulfanilamide was discontinued in 16 cases because of severe toxic manifestations.

Cyanosis possibly represents pigmentation and has nothing to do with the oxygen carrying power of the blood. First noticed in patchy blue areas about the cheeks and lips, it rapidly becomes generalized. We have seen it occur after 20 grains had been taken and occasionally diminish and even disappear though large doses of sulfanilamide were being given. As a rule it appeared on the second day of treatment and persisted for 3 days after the drug had been discontinued. It may occasionally interfere with accurate determination of hemoglobin by the colorimetric method and erythrocyte counts must be relied upon when other methods of estimation are not available.

We look upon nausea and vomiting as of gastro intestinal origin though it may be cerebral. Diarrhea apparently not due to infection, has been reported by Lockwood, Coburn and Stokinger, we have noted it in 8 cases.

Signs of cerebral irritation were dizziness, 4 cases, headache, 16 cases, and drowsiness, semi stupor, disorientation, excitement or nervousness in 10 cases. In 3 of these cases feeding was difficult.

We have found it difficult to identify drug fever beyond question in more than 3 cases. There were 9 other cases in which it appeared likely. Six of these patients were receiving large doses of sulfanilamide. The diagnosis of drug fever was made when, after a long afebrile or low febrile period of 5 to 7 days the temperature rose without corroborative evidence of increased puerperal infection and the drug was stopped, fever abated in a day or two.

Slow anemias were common. In many cases leucocytosis diminished or disappeared during

treatment, but this was attributed to control of the infection. Acute hemolytic anemia occurred in 2 cases and yielded rapidly to treatment. Since this toxic manifestation is of great importance as it may cause death, these cases are reported in some detail.

CASE 1 W H was admitted on December 22, 1938, with a diagnosis of threatened abortion, 4 months. Hemoglobin was 72 per cent, Sahli, red blood cells, 3,800,000, white blood cells, 11,000, 72 per cent polymorphonuclears. Vaginal swab showed gram negative intracellular diplococci.

Bleeding stopped soon after admission, and fever occurred on December 27, rising to 103.8 degrees on December 28 and 30, with severe remissions. Four doses of sulfanilamide, each 30 grains, were given on December 30 and one dose of 30 grains the next morning a total of 150 grains.

The next day she had a chill became extremely toxic, occasionally disoriented, vomited and became drowsy and jaundiced. Hemoglobin dropped to 38 per cent Sahli. Her blood showed 83 units for the icterus index, an immediate direct van den Bergh reaction, 5.0 milligrams of bilirubin, 64.2 milligrams of urea, and 194 milligrams of cholesterol. The urine of January 2 was positive for bile by the foam test. A later specimen showed a slight amount of bilirubin increased amounts of urobilinogen, and markedly increased amounts of urobilin. The severe anemia was accompanied by marked leucocytosis, up to 60,000 and nucleated erythrocytes and immature leucocyte forms. Later reticulocytes up to 5 per cent were noted.

She aborted a macerated fetus on January 4, 1939. Jaundice, drowsiness, and vomiting continued for 3 or 4 days, subsiding slowly. Treatment included high carbohydrate, low fat diet, and repeated blood transfusions. Marked improvement occurred on January 10, and she was discharged in good condition on January 18.

CASE 2 M C a colored multipara aged 30 years, was curetted on January 9, 1939 for incomplete abortion with temperature 100 degrees, pulse, 100, red blood cells, 4,200,000, hemoglobin 72 per cent Sahli. On January 11, temperature rose to 104 degrees, and 120 grains of sulfanilamide were given on that day, and the next. On the third day when 300 grains had been given her temperature fell to normal, but hemoglobin was found to be 32 per cent Sahli and red blood cells 2,030,000. This severe anemia was not accompanied by nausea, vomiting or jaundice. However, urinalysis showed increased amounts of urobilinogen and greatly increased amounts of urobilin. On January 17, icterus index was but 3 units. Repeated blood counts showed only a moderate leucocytosis, the highest 13,250 and nucleated red cells were found but once. She received two transfusions and iron medication and the hemoglobin rose to 50 per cent on January 21, when she was discharged for ambulatory treatment of the

anemia. This was thought to be acute hemolytic anemia in spite of the absence of usual confirmatory evidence.

SUMMARY AND CONCLUSIONS

Those who have had considerable experience with puerperal infection know that its prognosis is grave in its severe forms. The etiology, bacteriology, and pathology of a large number of cases must be thoroughly studied before the efficacy of any remedial agent can be demonstrated. A control series of alternate cases is futile, and comparison of mortality rates with previous experience is inconclusive, though helpful. It has been clearly shown by others that sulfanilamide has specific effect in infections caused by the beta strain of the hemolytic streptococcus. Whether genital tract infection by other organisms is susceptible to the drug is not yet clear, though it would appear to be. Possible untoward effects of any dangerous remedy must be assessed under carefully controlled conditions before its use is warranted. At any rate trial of sulfanilamide therapy involves no abandonment of any established method of treatment, except possibly forced fluid intake, for there are no proved remedies for puerperal infection.

Large doses of sulfanilamide were given to 118 patients with severe puerperal infections of the genital tract, regardless of their etiology. Clinical response was prompt and satisfactory in 45 cases, or 38 per cent. In an additional 45 cases, or 38 per cent, results were not convincing, yet good enough to make us feel that the drug may have played an important part in recovery. In 23 cases, or 20 per cent, no beneficial results were observed. There were 5 deaths, a mortality of 4 per cent.

Administration is definitely associated with toxic manifestations none of which need be a serious hazard. Usually obvious and rarely severe enough to warrant discontinuance of therapy, toxicity is actually low. A moderate fall in hemoglobin is common and harmless. We have seen no case of agranulocytosis. Acute hemolytic anemia can not be foreseen or prevented since it is apparently due to idiosyncrasy, developing quickly within the first few days of treatment after comparatively small doses of the drug. Rapid drop in

hemoglobin and erythrocytes leucocytosis, marked reticulocytosis, bilirubinemia and urobilinuria are noted. Daily blood counts for at least the first 5 days are essential. Though it occurs but seldom, and transfusion is effective, it is because of the ever present danger of serious blood changes that indiscriminate administration of sulfanilamide is inadvisable. Other toxic manifestations are readily observed clinically and subside when the drug is withdrawn.

In mild cases of puerperal infection sulfanilamide is not indicated. Certainly proper bacteriological investigation should precede therapy, but it is not essential. Intrapartum infections should be treated with sulfanilamide at once. Report on *Streptococcus hemolyticus* may be had in 24 hours, vaginal swab culture is better than intra uterine. If hemolytic streptococci are found drug therapy should be discontinued only under exceptional circumstances and one should not be too quick to stop its administration because bacteria have disappeared or a diagnosis of drug fever has been made.

Our most recent experience indicates that optimum benefit may be expected with spaced maintenance doses of 20 to 30 grains of sulfanilamide and moderate fluid restriction, provided a large initial dose has been given the patient.

In severe puerperal infections of the genital tract whatever their etiology, sulfanilamide may be used and should be, provided the patient is in a hospital where its administration may be controlled.

BIBLIOGRAPHY

- 1 BLISS E A, LONG P H and FRISTONE W H
South M J 1939 31 305
- 2 COLEBROOK L and HARE R Brit M J 1930 2 713
- 3 COLEBROOK L and MAXTED W R J Obst. & Gynaec Brit Emp 1933 40 966
- 4 COLEBROOK J and PURDIE A W Lancet 1932 1237 1295
- 5 COLEBROOK DORA C The source of infection in puerperal fever due to hemolytic streptococci. Special Report Series No 205 London His Majesty's Stationery Office 1935
- 6 FRY R M Brit M J 1936 2 345
- 7 HARE R Canadian Pub Health J 1937 28 334
- 8 LOCKWOOD J S, COBURN A F and STOCKEN T H E J Am M Ass 1938 111 1289
- 9 LONG P H, BLISS E A and FRISTONE W H J Am M Ass 1939 112 113

THE McCLURE-ALDRICH TEST IN WATER BALANCE FOLLOWING OPERATION

HOWARD C. HOPPS, B.S., M.D., Chicago, Illinois

FREDERICK CHRISTOPHLER, B.S., M.D., F.A.C.S., Evanston, Illinois

OF recent years surgeons have become increasingly aware of the prime importance of the maintenance of a proper water and electrolyte balance in the patient after operation. In the sick, surgical patient a water imbalance is particularly liable to occur because of the unusual losses of fluid from sweating during the operation, from vomiting, from enterostomies, from draining wounds, and from excessive metabolism. Moreover, in these cases it is often impossible for a time, at least, to administer oral fluids. Coller and Maddock (4), in a careful study of 18 surgical patients, found fluid losses varying from 95 to 1,979 grams during the operative period and from 140 to 738 grams in the 4 hours immediately after operation. In further studies Coller and Maddock (7) show that the average daily loss from the sick surgical patient is from two to three times that of the normal individual in exclusion of abnormal losses due to vomiting, draining wounds, fever, etc.

Ravdin and Rhoads state

The results of fluid deficit are probably only partially known but many of those with which we are familiar are particularly unfortunate at a time when the patient has just been operated upon. Unless the deficit is due to hemorrhage there will be an increased blood viscosity which tends to slow the circulation and increase the work of the heart. The urinary output is diminished at a time when there is often an increased breakdown of protein going on due to tissue injury at the operative site and to the substitution of protein for fat and carbohydrate as food. There are often toxic products of infection or of disintegrating tissue whose chief avenue of excretion is thought to be the kidney and whose excretion may be hindered by a low urinary output. If the urinary output is cut down sufficiently, uremia will develop. The kidneys will no longer be able to control the acid base equilibrium adequately at a time when starvation ketosis is present. If acidosis or alkalosis occurs it may incite vomiting with further dehydration, thus

forming a vicious circle. Diminished salivation commonly results which often makes the patient very uncomfortable and restless, and probably predisposes him to parotitis. Hyperpyrexia sometimes appears in dehydration because the sweat glands cannot excrete enough perspiration to control the body temperature.

The usual guides in the management of water balance after operation are (a) the clinical picture, (b) the urinary output, (c) quantitative measurements of intake and output, (d) the erythrocyte count, (e) the hemoglobin determination, and (f) the blood protein level. (10) The clinical picture of dry skin and dry tongue is unfortunately too familiar. As Cutting says, dehydration should never be allowed to develop in the surgical patient to the point where it is clinically recognizable. The urinary output is an excellent guide, but may be untrustworthy when kidney function is impaired, moreover, 24 hours may be required to make an accurate determination. The quantitative measurements of intake and output as described by Coller and Maddock are valuable, but so involved as to be beyond the scope of the average hospital. The red blood count and hemoglobin are variables often influenced by blood loss occurring during operation or in the period which follows. These values are also affected by the changes accompanying dehydration, notably that of increased blood viscosity which causes a barrier to the normal capillary circulation, and the destruction of red blood cells and hemoglobin which results from severe anhydremia of several days' duration. Blood protein determinations are difficult and time taking and may be influenced by a protein deficiency which is part of the patient's general picture after operation. Blood protein is destroyed when severe anhydremia has existed several days (8).

Another factor with which we must be concerned is the electrolytic balance inasmuch as

From the Division of Surgery Northwestern University Medical School Chicago Illinois

it is intimately bound with water metabolism and must be treated in conjunction with it. Of the electrolytes involved sodium⁺ is the most important. Much of the fluid lost abnormally by surgical patients is rich in sodium⁺ particularly that lost from the gastrointestinal or biliary tract. Consequently, in these patients there often results a dehydration that cannot be compensated for by water alone even though the red blood count and hemoglobin determinations return to normal and the urinary output is quantitatively sufficient. Nor is the danger of sodium⁺ deficiency all that need be guarded against. Because of the too liberal use of physiological saline or Ringer's solution as a routine fluid for intravenous use whether sodium chloride is needed or not an oversufficiency of sodium⁺ is frequently brought about sometimes to the extent that edema is clinically evident.

With these thoughts in mind a study was undertaken to determine the value of the McClure Aldrich test as a guide to the management of water balance after operation.

In 1923 W. B. McClure and C. A. Aldrich first introduced a test which has since borne their names consisting of a measurement of the disappearance time of an artificial injected wheal of normal saline. The test was originally applied in cases of nephritis in an effort to determine the thirst of subcutaneous tissues and thus estimate the severity, prognosis and progress of the disease (9). It has since received a wider application and has been used in the study of vascular disease (2, 3, 11), cardiac failure, toxemia of pregnancy, scarlet fever and other diseases. Its use has in general been limited to those conditions in which edema plays a part to measure the edema and detect it before it is clinically evident. Its efficiency in determining water balance under these conditions has been widely studied and proved (6). The mechanism of the test is in some dispute. The generally accepted mode of action is however that the disappearance of intradermal saline is due almost wholly to a dispersement of the fluid into the interstitial spaces and cells and that the length of time that this transfer takes as measured by the disappearance of the wheal is inversely proportional to the tissue avidity for water.

On this basis it seemed logical that the test would furnish a practical, accurate quantitative means of measuring water balance in the surgical patient. In reviewing the literature it was found that this application was first suggested in 1927 by Appel and Brill.

In the following study the management of water balance after operation was carried out independently of the McClure Aldrich test as a guide. Standardized equipment, including tuberculin syringes and No. 27 intradermal needles was used throughout. All intradermal injections were made and interpreted by the same individual. In each case when the McClure Aldrich test was used an average taken from multiple wheals was made. Intradermal injections of 0.2 cubic centimeter of an 0.8% per cent solution of sodium chloride were made in both forearms on the volar surface at the junction of middle and proximal thirds care being taken to avoid superficial veins and over the chest at points midway between the sternoclavicular joint and the apex of the anterior axillary fold. In those patients to whom intravenous fluids were administered the arm or arms affected were not used as sites of skin tests because of the fact that around the site of intravenous infusions there is usually a local disturbance of water balance.

McClure Aldrich tests were performed in the following patients from 4 to 2 hours before operation with 1 exception from 2 to 4 hours after operation and thence every 24 hours at approximately the same time each day until a near normal fluid balance was considered established. In all instances erythrocyte and hemoglobin determinations were made by the same individual at the same time the skin tests were done.

Patient G. S. (Fig. 1) a 59 year old white male entered the Evanston Hospital on October 1, 1938 with complaints of vomiting, epigastric pain and dizzy spells. In 1911 the patient was operated upon for perforated gastric ulcer. A gastrostomy was performed. Following this he was completely well until 1930 when typical ulcer symptoms recurred. In August 1938 9 weeks prior to admission he began to suffer from intermittent vomiting and progressively increasing epigastric soreness to the point of pain. During the 3 weeks prior to admission the patient had had a daily emesis of from 500 to 1000 cubic centimeters of greenish fluid. For the last 9 weeks there had been a tendency toward diarrhea and the

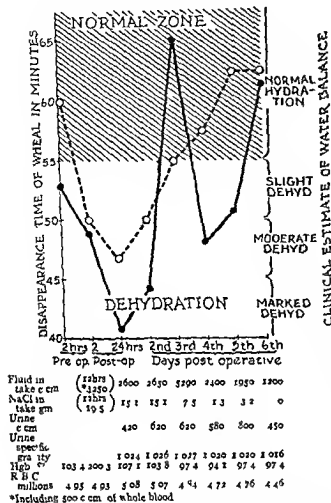


Fig 1 Gastro-enterostomy on G S male aged 50 years ○ ○ Clinical estimate of water balance ●—● Disappearance time of artificial wheal

stools had been black. There had been occasional transient attacks of vertigo during the last 3 weeks. There had been a weight loss of 30 pounds in the last year.

Physical examination revealed a rather thin white male who did not appear acutely ill. The abdomen presented a long midline scar. There was no tenderness or rigidity, but there was slight hyperperistalsis. Laboratory examination was negative save for the x ray film which revealed a duodenal ulcer with a high grade of obstruction. Diagnosis duodenal ulcer with almost complete obstruction at the pylorus.

The patient was placed under conservative ulcer management without satisfactory response. On the fourteenth day following admission a gastro enterostomy was performed. The operating time was 2 hours. Anesthesia was by means of drop ether. The patient's condition was poor throughout the latter part of the operation. He received 500 cubic centimeters of whole blood at that time. Eight hours after operation, the temperature rose to 102.2 degrees and then declined. On the second day after operation the patient became cyanotic and his pulse became fast and weak. Nasal oxygen relieved this

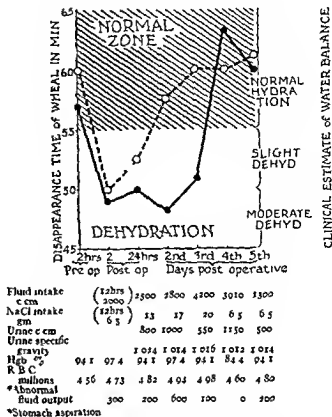


Fig 2 Gastric resection on F M male aged 45 years ○—○ Clinical estimate of water balance ●—● Disappearance time of artificial wheal

and on the following day he began to take fluids by mouth. Subsequent convalescence was uneventful and on October 20, 1938, the patient was discharged from the hospital.

Although this patient was hospitalized for 13 days prior to operation and clinically his state of hydration was thought to be well within normal, the McClure Aldrich test shows that he entered the operating room with a handicap, that of dehydration. This fact was perhaps responsible for the marked dehydration indicated by the wheal disappearance time 24 hours after operation, a degree of dehydration not observed clinically. It is of interest to note the sensitivity of the McClure-Aldrich test as demonstrated by the sharp rise in the curve on the third day after operation, on which day the fluid intake had been doubled, and how abruptly the curve falls when the previous rate of fluid administration was adopted. It is quite apparent that if the wheal disappearance time had been used as a guide for fluid administration in this patient, a state of dehydration could have

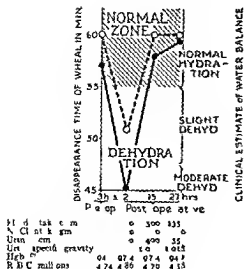


Fig. 3. Herniotomy on A. A male aged 53 years
 ○ Clinical estimate of water balance ●—● Disappearance time of artificial wheal

been prevented during the fourth and fifth days after operation

Patient F. M. (Fig. 4) a 45 year old white male entered the Evanston Hospital on October 15 1938 with complaints of epigastric pain abdominal distention nausea and vomiting. The onset of his present illness began in the fall of 1936 with occasional attacks of epigastric distress at mid morning. This became progressively worse and was accompanied by nausea and vomiting. He lost 18 pounds in 3 months. Relief was obtained only by sleep. In January 1937 3 months after onset of symptoms he was hospitalized. A gastro-intestinal series was negative but a stone in the left kidney and left ureteral stricture was found. A left nephrectomy was performed. Symptoms were relieved until July 1937 when there was an attack of hematuria accompanied by passage of several small stones. Epigastric pain recurred. This time relief was obtained upon taking bicarbonate of soda. A repetition of urinary symptoms occurred February 1938. The patient was again hospitalized and at that time x ray evidence of gastric ulcer was found. Medical management failed to give complete relief of gastro-intestinal symptoms and the patient was advised to undergo surgical treatment. The patient had had pneumonia with pleurisy in 1935 and an appendectomy had been performed in 1913.

Physical examination showed a well nourished white male who did not seem acutely ill. There was slight epigastric tenderness. Laboratory examination showed a slight leucocytosis. Diagnosis chronic peptic ulcer.

Five days following admission a gastric resection was done. Operating time was 3 hours and the patient's condition was good throughout. Anesthesia

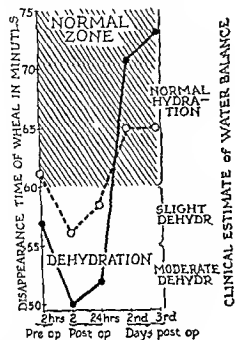
was by means of ethylene oxygen and ether closed method. The patient made satisfactory progress and was discharged on November 15 1938 in a convalescent state.

In this instance the McClure Aldrich test demonstrated a slight to moderate dehydration which persisted through the third day after operation and was relieved only when fluid intake was increased approximately 50 per cent. On the second and third days the dehydration present was not observed clinically and thus the patient was allowed to continue in a dehydrated state 2 days longer than necessary. It is of interest to note that although the McClure Aldrich test demonstrated a state of dehydration the urinary output varied daily from 550 to 1000 cubic centimeters and the specific gravity was as low as 1.014. This may indicate the unreliability of urinary studies in determining dehydration when intravenous fluids are being administered at such a rate that an overflow through the kidneys occurs.

Patient A. A. (Fig. 3) a 53 year old white male a laborer entered the Evanston Hospital on October 5 1938 with complaints of pain and swelling in the right groin of 7 years duration. Onset of the present illness began 7 years ago with the appearance of a symptomless diffuse swelling in the right groin. This had become progressively more pronounced and had of late been accompanied by burning pain. Upon straining or coughing a large mass descended into the scrotum. For 3 years the patient has been aware that he had high blood pressure. It had never caused symptoms. He is now recovering from a cold of 2 weeks duration.

Physical examination revealed a well developed and well nourished white male not acutely ill. The nasal mucosa was congested and the tonsils chronically inflamed. The heart was enlarged 3 centimeters to the left of the mid clavicular line. The blood pressure was 225/124. Upon inspecting the abdomen the right external inguinal ring was found to be enlarged admitting the index finger. A large mass protruded through this opening filling the right scrotum. Laboratory findings were essentially negative except for a mild leucocytosis and an electrocardiogram which revealed hypertensive heart disease. Diagnosis complete indirect inguinal hernia right and essential hypertension with hypertensive heart disease.

Six days after admission a herniotomy was performed. The operation was of 1 hour and 30 minutes duration during which the patient's condition was good. Anesthesia was by ethylene and oxygen closed method. Throughout the day of operation the patient's condition remained good. Temperature



Fluid intake c cm	(10hr)	3560	1600	2400
NaCl intake gm	(2300)	53	0	0
Urine c cm	(65)	775	1850	950
Urine specific gravity		1.010	1.010	1.016
Hrb °	90.0	87.6	81.2	87.6
R B C millions	4.75	3.70	3.57	3.92

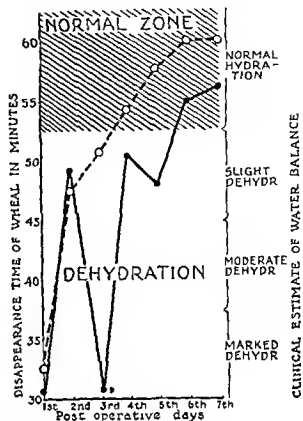
Fig 4. Herniotomy for strangulated femoral hernia. F S, male aged 59 years. O—O Clinical estimate of water balance. ●—● Disappearance time of artificial wheal.

rose to a peak of 99.6 degrees and then declined. Satisfactory progress was maintained and on October 23, 1938, the patient was discharged.

In this simple uncomplicated herniotomy, the wheal disappearance time parallels the clinical estimate of hydration, but throughout indicates slightly more dehydration than is perceptible by clinical observation.

Patient F S (Fig 4), a 59-year-old white male, entered the Evanston Hospital at 10:45 p.m., October 17, 1938, with complaint of severe upper abdominal colicky pain of 4 hours' duration. The pain developed insidiously, rapidly increasing in intensity, was paroxysmal and was accompanied by hyperperistalsis. There was no vomiting and bowel movements were normal. The patient was well prior to onset of above symptoms. Twenty-seven years ago the patient had a strangulated hernia with an attack similar to the present one. For the past year the patient has worn a truss for a left femoral hernia.

Physical examination revealed a well-developed, well-nourished white male in acute pain. The abdomen was generally tender and tense. There was moderate distention and hyperperistalsis. Laboratory examination revealed a leucocytosis of 12,100



Fluid intake c cm	1600	2600	2000	2270	2470	2030	2183
NaCl intake gm	20.8	24.8	3.25	1.7	6.5	6.5	0
Urine c cm	1200	1100	1050	1475	1000	1000	1300
Urine specific gravity		1.012	1.012	1.006	1.009	1.012	1.012
Hrb °	90.0	81.1	74.6	84.4	81.1	81.2	84.4
R B C millions	4.35	4.06	3.86	4.20	4.17	4.44	4.28

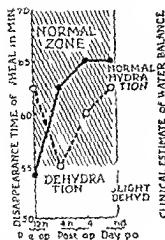
*Slight pitting edema present attributable perhaps to NaCl intake of previous 24 hours.

Fig 5. Gastric resection on M H, female aged 11 years. O—O Clinical estimate of water balance. ●—● Disappearance time of artificial wheal.

white blood cells. X-ray examination demonstrated an acute intestinal obstruction. Diagnosis: strangulated femoral hernia.

Sixteen hours after admission the patient was operated upon; the intestinal obstruction relieved, and the femoral hernia repaired. Operating time was 1 hour and 10 minutes. The patient's condition remained good throughout. Anesthesia was by means of ethylene, oxygen, and ether, closed method. The patient made satisfactory progress and was discharged on October 28, 1938.

Again we see by means of the McClure Aldrich test, that slight dehydration was present upon onset of operation, a state of unpreparedness which could have been overcome had its presence been recognizable clinically. We see that a moderate dehydration exists for 24 hours after operation, unobserved clinically.



Fl d i k e m	(hrs)	750	1500
U l i n t a k e g m	(16 hrs)	0	0
U n o c m	(15 s)	4	5
L n p e r i t g r a v i t			
H g h c m		77.9	81.4
R B C m i l l		3.34	4.45
500 m i w h o l b l o o d i n c l		4.45	3.98

Fig 5. Resection of rectum on B. L. female aged 70 years. ○ ○ Clinical estimate of water balance. ● — ● Disappearance time of artificial wheal.

Patient M. H. (Fig 5) an 11 year old white female entered the Evanston Hospital on October 3 1938 complaining of hematemesis for 2 days inability to retain food or water in stomach for 3 days and weakness and thirst for 1 day. She had been perfectly well prior to the onset of symptoms 2 days previously. Physical examination disclosed a marked weakness and marked evidence of dehydration. There was bilaterally a mild cervical lymph adenopathy. In the abdomen there was found a smooth firm tender mass slightly mobile present in the upper part of the left lower quadrant. Its diameter was about 8 centimeters. Laboratory findings were essentially negative. Hemoglobin was 90 g per cent (Haden Hauser) and red blood cells 4.30. Roentgenographic examination showed a large tumor mass encroaching on the duodenal bulb apparently intrinsic in origin. Pre operative diagnosis tumor of the stomach.

Twenty three hours following admission the patient was operated upon. A wide gastric resection was performed. Operating time was 2 hours and 40 minutes and the patient's condition remained good throughout. Anesthesia was by means of autogenous oxygen and ether closed method. During the operation 500 cubic centimeters of normal saline and 300 cubic centimeters of whole blood were given. Throughout the day of operation the patient's condition remained good. The temperature rose to a peak of 103 degrees after operation and then declined. Convalescence was uncomplicated save by occa-

sional nausea. On the fourth day she began taking fluids by mouth. On October 10 the patient was discharged. The pathological diagnosis was malignant leiomyoma of the stomach.

It is quite significant to note that whereas the clinical estimate and the McClure Aldrich test almost coincide as regards the dehydration present the first and second days after operation, on the third day a marked discrepancy occurs. On that day a slight pitting edema was perceptible which we attributed to the excessive sodium chloride intake of the previous 48 hours. Indirectly relating this finding to the wheal disappearance time, it may again be emphasized that the McClure Aldrich test is a means of measuring tissue aridity for water, whether that aridity is caused by insufficient water present or because the water present is in a large measure bound and unutilizable. In this instance we believe that although an excess of water was present as indicated by edema, an excess of sodium⁺ was responsible for the fact that most of the water was bound and hence was unavailable to the tissues. When the sodium chloride intake was markedly decreased, the wheal disappearance time returned to its former level. The progressive decrease of erythrocytes and hemoglobin for the first 3 days after operation demonstrates the fact that they are of no value in estimating dehydration when bleeding is a part of the clinical picture.

Patient B. L. (Fig 6) a 70 year old white female entered the Evanston Hospital at 11 00 p.m. on October 17 1938 with a present illness of 6 months duration. In April of 1938 she first noticed blood in the stool a finding which has since occurred frequently. Two weeks prior to admission she began to notice a definite change in bowel habit diarrhea alternating with constipation. Dark red blood in the stool was a constant finding. She was able to continue normal activity until the day of admission when at 6 00 p.m. she passed a large amount of blood both fluid and clots per rectum. In the 2 hours prior to admission she had 4 large hemorrhages per rectum.

Physical examination revealed a pale patient with a pulse of 108. There was a large cauliflower mass in the rectum revealed upon digital examination. Laboratory examination revealed a hemoglobin of 90 g (Haden Hauser) and erythrocytes numbering 3.98. There was a leucocytosis of 17 600. Diagnosis injected ulcerated primary adenocarcinoma of the rectum.

Within 2 hours following admission there were 2 additional hemorrhages per rectum. An obstructive resection was performed 10 hours following admission and opened the second day after operation. Satisfactory progress followed this, although hemoglobin and erythrocytes progressively declined to 71.4 and 3.51, respectively. On November 2, 1938, 14 days following the colostomy, a posterior resection of the rectum was done. The operation lasted 1 hour and 45 minutes. The patient's condition remained good throughout. Anesthesia was by ethylene, oxygen and ether, closed method. Convalescence was uneventful and the patient was discharged November 27, 1938.

In this study the McClure Aldrich test indicates, paradoxically and in direct contradiction to clinical observation, a state of dehydration present prior to operation and relieved following operation. Upon analyzing the fluid intake of the period immediately following operation, however, this is understandable. Nearly 3,000 cubic centimeters of fluids were given in the 4 hour period following operation, 500 cubic centimeters of which was whole blood. Prior to operation it is seen that a moderate grade of anemia existed. Following the 500 cubic centimeters' blood transfusion, this anemia was relieved. One may conjecture that, in addition to the total fluids supplied, perhaps the "water binding" capacity of the blood was increased thus providing a greater reservoir of water from which the tissues could draw.

Patient A. G. (Fig. 7), a 32 year old white female entered the Evanston Hospital on October 30, 1938, with complaints of pain in the epigastrium and right upper abdomen, abdominal distention with eructation, nausea, vomiting and clay colored stools. Five years previously following the birth of her seventh child onset of the present symptoms began. Symptoms were associated with intermittent attacks of clay colored stools without evidence of jaundice. These symptoms became more severe and lately had become complicated by attacks of severe upper right abdominal pain, knife like in character, which radiated to the right shoulder. These attacks occurred every 2 or 3 days and persisted for 3 hours. There was a history of a similar attack 15 years before.

Laboratory examination was essentially negative save for an x ray finding of cholelithiasis. Diagnosis cholesterosis and cholelithiasis. Physical examination revealed a well developed well nourished white female who did not appear acutely ill. There was tenderness in the gall bladder region. Findings were otherwise negative.

The third day following admission a cholecystectomy was performed. Operating time was 50 min.

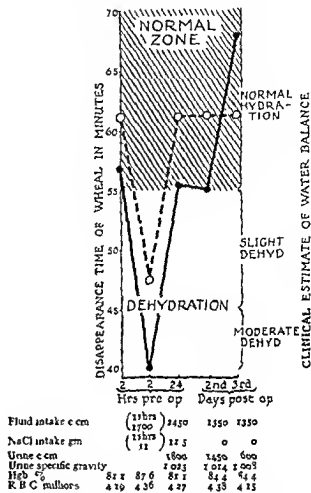


Fig. 7. Cholecystectomy on A. G. female aged 32 years. O—O Clinical estimate of water balance. —●— Disappearance time of artificial wheal.

utes and the patient's condition remained good throughout. Anesthesia was by means of nitrous oxide, oxygen, and ether, closed method. Convalescence was uneventful and the patient was discharged November 16, 1938.

Observation clinically and by the McClure-Aldrich test are seen to parallel each other closely, but again it is evident that by clinical estimation dehydration is underestimated.

CONCLUSIONS

1. The McClure Aldrich test was used in 7 patients after operation in an effort to determine its value as a guide to the state of hydration and detailed reports are presented.

2. In the cases studied the McClure Aldrich test was found to be a sensitive and reliable index to the state of hydration. It was found to be a useful guide to the optimal fluid administrations provided the electrolytic balance was taken into consideration.

3 Although this series is too small to be conclusive, the McClure Aldrich test appears to be a valuable adjunct to the clinical appearance of the patient, to the intake and output studies, and to the blood studies in the estimation of hydration after operation

BIBLIOGRAPHY

- 1 APPEL KENNETH E. and BRILL, SELLING Post operative water metabolism and the intradermal salt solution test. *Ann Surg* 1937 85 502
- 2 COHEN MILTON B. The intracutaneous salt test. *J Am M Ass* 1925 84 1561
- 3 COHEN MILTON B. APPLEBAUM H S. and HAINSE WORTH E L. The intracutaneous salt solution test. *J Am M Ass* 1926 86 1677
- 4 COLLEF FREDERICK A. and MADDOCK WALTER G. Dehydration attendant on surgical operation. *J Am M Ass* 1931 99 875
- 5 CUTTING REGINALD A. Principles of preoperative and postoperative treatment. New York Paul B Hoeber Inc 1933
- 6 KUNDE MARGARET M. Correlation of elastometer findings disappearance time for intradermally injected salt solution. *unanalysis and nitrogen retention of the blood in edema*. *Arch. Int. Med.* 1926 33 57
- 7 MADDOCK WALTER G. and COLLEF FREDERICK A. Water balance in surgery. *J Am. M Ass.* 1937 108 1
- 8 MARRIOTT W M. Anhydremia. *Physiol. Rev* 1923 3 275
- 9 MCCLURE W B. and ALDRICH C A. Time required for disappearance of intradermally injected salt solution. *J Am M Ass* 1923 81 193
- 10 RAYDEN I S. and RHOADS J E. Certain problems illustrating the importance of a knowledge of biochemistry by the surgeon. *Surg Clin N America*, 1935 15 85
- 11 STEIN WALTER G. and COHEN MILTON B. The intracutaneous salt solution wheal test. *J Am. M Ass* 1926 87 1355

THE SIGNIFICANCE OF THE RADIATION REACTION IN CARCINOMA OF THE CERVIX UTERI

SHIELDS WARREN, M D, JOE V MEIGS, M D, F A C S, ALVIN O SEVERANCE, M D,
and HENRY L JAFFE, M D,
Boston, Massachusetts

PATHOLOGICAL study of material derived from the first 70 cases of carcinoma of the cervix treated in the Pondville Hospital by the method of Meigs and Dresser brought out several interesting and important observations

The first of these throws further light on the significance of histological grading in group prognosis, the second, on the significance of histological evidence of radiation change noted in the tumor cells, third, on the significance of radiation changes in the supporting stroma of the tumors

In most cases, a biopsy was taken before treatment, in others, after the x ray treatment had been completed, in others, after the x ray and radium treatment had been completed. In 5 cases no biopsies were taken at Pondville, the initial diagnosis having been established by biopsy at the hospital from which they were referred. The ideal procedure is to take the initial diagnostic biopsy, then one after completion of the x ray treatment, one after the first radium treatment, one after the second radium treatment, and one 3 months later

These 70 cases, when divided into clinical groups, showed 8 to fall in the A and B groups, and 62 in the C and D groups. When divided according to histological grades, we found 1 epidermoid carcinoma, Grade I, 25 epidermoid carcinomas, Grade II, 32 epidermoid carcinomas, Grade III, 4 epidermoid carcinomas, ungraded, 3 adenocarcinomas, 1 undifferentiated carcinoma, and 4 epidermoid carcinomas according to biopsies at other hospitals and were checked in this laboratory

We have divided the cases into three grades histologically, of which Grade I is the lowest,

and Grade III the highest. In Grade I we require the presence of numerous epithelial pearls, as well as a considerable degree of keratinization. Intercellular bridges must be readily visible. Mitoses average less than 2 per high power field. There is only slight variation in size and shape of the tumor cells. In Grade II, there are rare, or no epithelial pearls, a moderate amount of keratinization, some intercellular bridges, an average of 2 to 4 mitotic figures per high power field, moderate degree of variation in size and shape of tumor cells. In Grade III there are no epithelial pearls, there is only slight evidence of keratinization, intercellular bridges are not distinguishable, mitoses average over 4 per high power field, there is often marked variation in size and shape of tumor cells, with numerous tumor giant cells. Occasionally, the tumor cells may be small, elongated, and closely packed.

In estimating the presence and degree of radiation reaction of both stroma and tumor cells, we have used two main categories—moderate radiation reaction, and marked radiation reaction. In case of a moderate radiation reaction shown by the tumor cells, the following points are required: (1) a diminution of mitotic activity, (2) some necrosis, (3) some vacuolization of cytoplasm, (4) in spite of these changes, the tumor is still readily recognizable.

For a marked reaction: (1) Mitoses are very rare, or absent, (2) there is much necrosis, (3) practically all the cells are abnormal, either vacuolated, markedly distorted, or swollen with large, hyperchromatic nuclei, (4) only scattered tumor cells, or small clusters present.

For a moderate radiation reaction in the stroma, we have required (1) the presence

TABLE I—SIGNIFICANCE OF EXTENT AND HISTOLOGICAL GRADE OF TUMOR BEFORE TREATMENT

Clinical classification	Grade I			Grade II			Grade III			Not graded			Adenocarcinoma			Miscellaneous		
	No.	Result		No.	Result		No.	Result		No.	Result		No.	Result		No.	Result	
		Living	Dead		Living	Dead		Living	Dead		Living	Dead		Living	Dead		Living	Dead
A	0	—	—	3	3	—	0	—	—	2	2	—	0	—	—	—	—	5
B	1	—	—	1	1	—	0	—	—	0	—	—	0	—	—	—	—	3
C	1	—	—	17	2	15	21	7	14	1	—	—	2	—	—	—	1	46
D	0	—	—	4	—	4	0	1	8	1	—	—	1	—	—	1	1	7
Totals	2	—	—	25	6	19	21	8	22	4	—	—	3	—	—	2	17	77

TABLE II—DEGREE OF RADIATION REACTION OF TUMOR AFTER X RAY TREATMENT—CORRELATED WITH END RESULT

Radiation reaction	Living	Dead	Totals
Moderate	10	18	28
Marked	20	14	34
None	1	9	10
No tumor present	1	2	3
No biopsy	2	3	5
Totals	34	46	80

TABLE IV—DEGREE OF RADIATION REACTION NOTED IN STROMA AFTER X RAY TREATMENT

Radiation reaction	Living	Dead	Totals
Moderate	14	19	33
Marked	6	11	17
None	2	10	12
No stroma	0	3	3
No biopsy	2	3	5
Totals	24	46	70

TABLE III—DEGREE OF RADIATION REACTION ON TUMOR AFTER X RAY AND RADIUM TREATMENTS

Radiation reaction	Living	Dead	Totals
Moderate	3	7	10
Marked	10	19	29
None	0	5	5
No tumor	5	6	11
No biopsy	6	9	15
Totals	24	46	70

TABLE V—DEGREE OF RADIATION REACTION IN STROMA AFTER X RAY AND RADIUM TREATMENTS

Radiation reaction	Living	Dead	Totals
Moderate	6	10	16
Marked	10	17	27
None	0	7	7
No tumor	6	7	13
No biopsy	2	5	7
Totals	24	46	70

of mild telangiectasis or thrombosis (2) slight increase of fibrosis (3) mild hyalinization of collagen (4) in the later period following radiation slight thickening of arteriolar walls and those of venules with hyaline deposition.

For marked reaction we have required (1) a marked thickening of vessel walls with hyaline deposition or actual necrosis of the walls with thrombosis (2) an appreciable increase in fibrosis (3) marked hyalinization of the collagen sometimes with foci of necrosis.

We have based the determination of necrosis in the tumor cells on (1) acidophilic staining of the cytoplasm and indefiniteness of that staining, (2) pyknosis of nuclei, or loss of nuclear material, (3) karyorrhexis, (4) in

vasion of cells by polymorphonuclear leucocytes (5) loss of cell membranes.

Certain alterations in the tissues resembling radiation reaction must be guarded against. These are cellular, chiefly cytoplasmic swelling due to contact of the tissues with hypotonic fluids after removal of the biopsy specimen and intercellular chiefly the hyalinization of collagen and of vessel walls as a result of physiological aging of the tissues or of previous cauterization. After some experience they may be largely eliminated as a source of error.

In Table I the clinical and histological grades, and percentage of deaths and survivals are presented. It will be seen at once that there are too few cases in Grade I and

the miscellaneous group to be of significance. However, in Grade II, 44 per cent of the patients survived, as against 28 per cent for Grade III, indicating that the group prognosis is slightly better in the lower histological grades.

The clinical grouping has definitely greater significance, only 1 patient in 8 dying in the A and B groups, and 74 per cent of the C and D groups being dead at the end of the 5 year period. It may be concluded that clinical is far more important than histological grouping.

While the grading of the initial biopsy is not of prognostic value for the individual, either from the standpoint of immediate response to radiation or of ultimate survival, the post radiation biopsies are most helpful.

Even the biopsy immediately after the series of x ray treatments is helpful (Table II). All but one of the cured patients showed a definite radiation reaction of the tumor cells. Ninety per cent of the group without evidence of radiation reaction died, whereas 64 per cent of those showing a moderate reaction died and 58 per cent of these showing a marked reaction.

The response after x ray and radium treatments is similar (Table III), all those without reaction dying, as well as 7 in 10, or 70 per cent, and 19 out of 29, or 66 per cent, respectively, of those with moderate and marked reactions.

The stromal response following x ray treatment is of almost equal value (Table IV). 10 of 12, or 87 per cent, of those without reaction dying, whereas 19 of 33, or 58 per cent, of those with moderate reaction, and 11 of 17, or 65 per cent, of those with marked reaction died.

Following both x ray and radium treatment (Table V), there are no survivors in the group without stromal reaction, 10 of 16, or 63 per cent dead in the group with moderate reaction, and 17 of 27, or 63 per cent, dead in the group with marked reaction.

The biopsies are undoubtedly fairer samples of the radiation response than is often the case, as in this group the radiation is unusually evenly distributed through the tissues.

SUMMARY AND CONCLUSIONS

- 1 The histological grade is of less importance in prognosis than the clinical classification.

- 2 The response to radiation of either tumor cells or stroma is a definite guide to radio resistant cases, practically all those failing to show radiation changes on the early biopsies die of their carcinoma in spite of intensive radiation therapy. We believe such cases should be treated surgically.

- 3 Absence of radiation reaction in the biopsies indicates a strong probability of ultimate death of the patient from the cancer.

MULTIPLE MYELOMA

RALPH K. GHORMLEY M D F A C S and GEORGE A. POLLOCK F R C S Ed
Rochester, Minnesota

THE disease, multiple myeloma, has long been recognized as an entity. On November 1, 1845, Henry Bence Jones received this note from Watson with a test tube containing a thick yellow semisolid substance. The tube contains urine of very high specific gravity, when boiled it becomes highly opaque. On the addition of nitric acid it effervesces, assumes a reddish hue, becomes quite clear but as it cools assumes the consistency and appearance which you see, heat relieves it. What is it? Watson and MacIntyre sent him many specimens from which he isolated an oxide of albumin which on ultimate analysis was found to be the hydrated deutoxide of albumin.

In 1846 there appeared a report on the examination of two lumbar vertebrae and a rib affected by *mollities ossium* by Dalrymple. He stated the disease appears to have commenced in the cancellated structure of the bone for the external osseous laminae are firmer and more healthy than the internal. The smoother surface of the rib, however, is raised by internal growths elevating the outer laminae here and there into irregularly sized and rounded dark red projections visible through the periosteal covering. The outer layers are steel hard requiring the exertion of some force to cut them; they are thin, however, and when sliced expose large cancellous cavities filled by a red gelatiniform substance threaded here and there by fine bony fibers. It is in these fibers of still existing bone that many of the more important morbid changes may be witnessed.

These gentlemen deserve the credit for first describing the disease, although they considered the lesion one of "*mollities ossium*." However, von Rustizky, in 1873, was the first to describe the disease under the name multiple myeloma, and Kahler in 1899, was

credited with the first description of multiple myeloma in connection with the excretion of Bence Jones bodies in the urine. Wright first described the cells of multiple myeloma as plasma cells and proposed the name "plasma cell myeloma."

Since then, several papers and numerous reports of cases have been recorded in the literature, all of which discuss the clinical and pathological picture which is fairly well known. However, a good many cases are not what might be called typical and these variations from the so-called typical case give the most difficulty in diagnosis. Knowledge of the condition has increased steadily until, now there may be found in the literature many excellent articles setting forth our knowledge of the disease. However, the etiology of the disease is still obscure and any effective treatment may be said to be unknown. One must admit, however, that recognition of the disease is very important from the standpoint of offering the patient an accurate prognosis. Such a diagnosis often can be made in fairly advanced cases by recognition of the multiple small punched-out areas in the vertebrae, ribs, skull, and pelvis on roentgenological examination (Figs 1 to 4). However, there are many variations from the typical clinical and roentgenographical picture and often all other findings are negative or are not sufficiently significant to be of any help in diagnosis.

Our object in conducting this review was to discover, if possible, any facts that could add to our diagnostic acumen when confronted with a case of this disease.

It is probably true that most cases cannot be recognized until a fairly advanced stage of the disease has been reached. There are no symptoms which are pathognomonic of the disease. The most frequent and usually the first complaint was backache in some; this was definitely localized but, in others, it was

vague and ill defined. Early roentgenological examination in a large number of those cases gave little, if any, evidence of bony change to account for the pain, frequently very severe, from which those patients suffered. In marked contrast with this, we were astonished to observe patients having extensive areas of destruction of bone in the skull and ribs continuing to lead comparatively comfortable lives with little limitation of their activity or derangement of their general health. Tumefaction as an early indication of myeloma occurred rarely and only in cases in which the tissue affected occupied a superficial position.

In our series, neurological signs owing to root pressure with pain referred to the abdomen and legs were noted in 2 cases of paresis of the limbs and urinary bladder. The terminal stages usually were ushered in by rapid loss of weight, progressive weakness, and a severe degree of anemia. Death resulted from inanition, uremia and other profound toxemia.

In many instances the laboratory findings are negative and therefore are of no help. The finding of Bence Jones proteinuria may be a lead but it must always be remembered that, in many cases of multiple myeloma, examination of the urine for Bence Jones protein gives negative results and, so far as we know, Bence Jones protein may never appear in the course of the disease. Thus, there are often only two alternatives: first, to suspect the disease and ask the patient to return for re-examination 3 or 4 months later when a sufficient change in the pathological picture may have taken place to make the diagnosis obvious, and second to perform a biopsy. The presence of myeloid immaturity in the blood smear, associated with a greasy appearance as described by Watkins, although not pathognomonic, if associated with other findings is strongly indicative of involvement of bone marrow and frequently of the presence of multiple myeloma.

Between January 1924, and January 1937, a diagnosis of multiple myeloma was made in 120 cases at The Mayo Clinic. In reviewing this group of cases, all available records and roentgenograms have been re-examined. Of the 120 cases, we have discarded 34 in which the diagnosis did not seem certain enough to

be included on the basis of recorded facts. Thus, we have 86 cases remaining from which we have drawn the following study. In order to simplify the findings we have divided this group of 86 cases into 5 groups as follows:

Group A 19 cases in which the diagnosis was proved by postmortem examination, biopsy, or both.

Group B 53 cases in which the diagnosis has been made on the basis of clinical and roentgenological findings.

In both group A and group B all patients have died.

Group C 5 cases in which the diagnosis was made on clinical and roentgenological evidence.

No follow up report has been received from any one of these patients. One may assume that all of these patients are dead.

Group D 6 patients proved by biopsy to have multiple myeloma are still alive.

Group E 3 patients still alive 1 year or more after the original diagnosis was made. The diagnosis was made on the basis of clinical and roentgenological findings, a biopsy was not performed.

An intensive follow up system was employed in which data were obtained from the patients or their relatives, the family physicians and the district clerk, if other sources of information were not available. In only five cases were we unsuccessful in obtaining information.

GROUP A

All 19 patients included in this group were proved to have multiple myeloma. Thirteen cases were diagnosed by biopsy, 3 were proved at necropsy and the remaining 3 were proved by both biopsy and postmortem examination. Fifteen patients were men and 4 were women. In 9 cases, pathological fracture could be demonstrated (47.3 per cent). Bence Jones proteinuria was found in 6 of the 17 cases in which the determination was made (35 per cent) and in one other, Bence Jones protein was discovered in the blood, later disappearing but at no time was there any evidence of Bence Jones bodies in the urine. Renal dysfunction, or nephrosis, was found in 14 cases of the group (73.6 per cent). An estimation of the albumin globulin ratio was



Fig. 1. a left. A woman aged 58 years. Typical appearance of multiple myeloma. Patient had Bence Jones bodies in urine. b humeri of same patient showing same type of lesion as seen in skull.



Fig. 2. A man aged 62 years. Symptoms for 1 year. Biopsy showed multiple myeloma. Roentgenogram shows involvement of tibia and femur.

made in 3 cases only with normal findings and without a suggestion of a reversal.

Owing to the presence of one unusually young individual in this group the average age for the group is 47 years. However it should be noted that there are only 4 patients of the group less than 40 years of age and that the largest group of any decade is 6 cases between the ages of 50 and 60 years.

The average duration of the disease from the apparent time of onset to death was 68 months the shortest duration 3 months and the longest 55 months. The average duration of the disease from the time biopsy was performed to death was 14.05 months. The shortest duration was 1 month and the longest 58 months.

The sites of the lesions at the time of examination at the clinic as far as we were able to determine from available roentgenograms were as follows: vertebrae 19 cases, skull 11, ribs 9, femurs 8, humerus 3, scapulas and clavicles 3, tibiae 2 and radius 1 case. We should point out the fact that in many of these cases it was not possible to make com-

plete roentgenological studies therefore the foregoing figures are not complete. We would also point to the fact that ultimately the involvement in many of these cases must have been more extensive than these figures indicate. Regarding the significance of evidence of renal irritation the presence of definite renal damage has long been recognized. Its significance is perhaps not well understood. Bannick and Greene said that renal damage is the result of destructive processes in the kidney either tubular destruction with subsequent fibrosis or pyelonephritis.

The incidence of Bence Jones proteinuria in these cases should be noted. Usually quoted statistics show a higher incidence 65 to 70 per cent. Why we found such a low incidence in this group cannot be explained easily. In the 6 cases the determination of Bence Jones proteinuria was recorded in 14 cases. In 6 of these Bence Jones proteinuria was present and in 11 a negative reaction for Bence Jones proteinuria was obtained. Thus in the cases in which the determination was carried out 35 per cent gave positive evidence of Bence Jones proteinuria. A positive test for Bence Jones protein in the blood was obtained in 1 case in which examination of the urine gave negative result for Bence Jones proteinuria. Regarding the significance of Bence Jones proteinuria the fol-



Fig 3 left A man aged 40 years. Extensive lesion of spine pelvic bones and femurs proved by biopsy to be multiple myeloma.

Fig 4 A man aged 38 years. Pathological fracture of right acetabulum 1 year previous to admission. Biopsy showed multiple myeloma.

Following facts are gleaned from some conclusions of Magnus Levy in a paper published on this subject in 1932. The output of Bence Jones protein in the urine is dependent on nitrogenous changes. It is not exclusively an end product. In cachectic states it may disappear from the urine. The usual serum proteins can disappear from the urine in the presence of a severe degree of Bence Jones proteinuria. In cases of proteinuria without myeloma the marrow is usually diseased. The amount of Bence Jones protein lost by way of the urine is seldom more than 1 gram a day. Proteinuria is absent in 20 to 25 per cent of cases of myeloma. Bence Jones protein may be found in the blood and in exudates but in lesser amounts in the bone marrow. Bence Jones protein is usually formed in the bone marrow. Formation of protein in other tumors is not so high as it is in cases of myeloma. Normal marrow possibly can produce Bence Jones proteinuria.

Table I contains data available concerning various constituents of the blood in these cases. Unfortunately the data are only fragmentary and were not consistently obtained in all cases. The fact that there are 19 proved cases of myeloma makes them worth publishing however. If a concentration of hemoglobin of 80 per cent or less (Dare) is con-

sidered as indicative of anemia there were 11 cases of anemia in the series.

GROUP B

All of the members of this group have died. We cannot be absolutely certain of the diagnosis because positive proof was not obtained. However the clinical and roentgenological evidence was significant enough and make us feel that the diagnosis was accurate. Forty patients were men and 13 were women. The largest number of men were between the ages of 50 and 60 years whereas the largest number of women were between the ages of 60 and 70 years. The longest duration of life from the time the diagnosis was made until death was 4 years, the shortest duration of life was 3 weeks. Calculating the duration of life from the onset of symptoms until death the interval varied from 3 months to 10 years. Bence Jones proteinuria was found in 34 cases (64 per cent). In 16 cases (30 per cent) a pathological fracture could be demonstrated in the ribs or vertebrae. A history of injury was obtained in 14 cases. Nephrosis or nephritis was present to an extreme degree in 32 cases (60 per cent).

In addition to these findings there were noted (1) an increase in the concentration of uric acid in the blood in 3 of the 4 cases in-

TABLE I—AVAILABLE DATA CONCERNING THE BLOOD

		L. C. 60												
I t t n		1	2	3	4	5	6	7	8	9	10	11	12	13
Serum If test	rm l 5 mg %	4.5												31.6
Urea	m l 0.4 mg %	44						20	2	61	15			5.7
Chloride	m l 0.4 mg %	9	30	9.8	1.7		9.5		9	0.2	1	3	9.0	2.5
Phosphorus	rm l 1 mg %	3.4	2	5.8	4		5.3		4	4.7	3	4	3	6.4
Pb	ph l 10 e l m l 5 u l h l i r e n h a b l	1.3											5.8	1.9
Bil	rd hl rd rm l 0.6 mg %	30						6.7	6.6					
C	gul t t me n rm l 0.4 m %	3												
Bleed	g t me (rm l 3 m l es)	3												
Serum lb nu	(0 m l 3-6 mg %)			3.4										
Serum protei	rm l 6-8 mg %			3.8 m			6.5						6.08	6.9
C bon d ad c mixtu g	power (rm l 53-65 vols %)							64.5	46					
Edm t t	t (rm l les th mm pe h)						5						5.1	90.12
L t n	(rm l m l)												9.6	1

† T min l dings
‡ Cases 4, 7, 15 and 16 the per l exy l s removed th l p l were t med out.

investigated (1) an elevation of the sedimentation rate in 3 of the 8 cases investigated (2) the albumin globulin ratio was reversed in 3 of the 7 cases investigated (3) a definite lowering of the blood cholesterol was found in 1 of 3 cases (4) the concentration of creatinine was more than 2 milligrams per 100 cubic centimeters in 4 of the 6 cases investigated and (5) serum protein was elevated more than 9 milligrams in 4 of 11 cases.

The bones involved in this group of cases were as follows: vertebrae 36 pelvis 20 skull 39 ribs 3 femurs 14 humerus 10 scapulas and clavicles 10 tibiae 2 radius 2 sternum 2 maxilla 1 ulna 1 and bones of the hand, 1

GROUP C

The absence of follow up records in this group makes the available statistics of questionable value. One may presume that the

patients of this group are dead. The following facts are noted: the group contained 4 men and 1 woman whose ages ranged between 40 and 70 years; the average age for the group was 57 years.

GROUP D

The 6 members of this group are alive. The presence of multiple myeloma was proved by a biopsy in each case. For these reasons these cases have been checked more carefully than those of other groups. A brief summary of each case seems worth recording.

CASE 1 A woman aged 20 years had experienced pain for 6 months and paraplegia for 3 months. Laminectomy was performed and a tumor was removed and diagnosed as myeloma by the pathologist. Recovery did not occur but the patient was alive 21 months after the onset of symptoms.

CASE 2 A man aged 62 years 16 years ago noticed huskiness of his voice. Roentgen therapy was given with improvement. The huskiness recurred 2 years before admission. An ulcer was found on the pos-

terior surface of the tongue and was diagnosed as myeloma. Since then he has been in good health (2 years). Evidence of involvement of bone could not be found.

CASE 3 A man aged 41 years 4 months before admission noticed puffiness over his left eye and swelling of the left side of his head. Roentgenological examination gave evidence of a large area of destruction in the skull. A tumor was removed to gether with the overlying skull and dura which on histological examination proved to be a myelocytoma. He is now apparently well 29 months after the operation.

CASE 4 A woman aged 46 years had a tonsillectomy performed 3 months before coming to the clinic. She later had a tooth extracted but swelling of the cheek persisted. On admission to the clinic a destructive lesion of the antrum was discovered as well as lesions of the skull pelvis and femurs. Biopsy of the antral lesion showed it to be a multiple myeloma. Deep roentgen therapy was given and the patient was last reported to be in good condition 17 months after the onset of the symptoms.

CASE 5 A woman aged 53 years on her first admission to the clinic gave a history of backache of 3 years duration and of sciatic pain of 1 year's duration. Roentgenological examination gave evidence of extensive destruction of half of the sacrum with some suggestive lesion of the skull. A diagnosis of multiple myeloma was made. Roentgen therapy was given and the patient returned to the clinic almost 2 years later. At this time there was roentgenological evidence of only slight extension of the destructive process, thus a biopsy was performed and the lesion was found to be a multiple myeloma. She is still alive 5 years after onset of the symptoms.

CASE 6 A man aged 38 years first reported at the clinic in December 1910. He complained of pain in the chest of 1 year's duration and weakness and stiffness of one leg of 3 weeks duration. Roentgenological examination gave evidence of partial destruction of the fifth dorsal vertebra and on account of the paraplegia a laminectomy was done and a multiple myeloma was found. Roentgen therapy improved his condition. He is still alive (8 years) but has had another laminectomy performed elsewhere and the diagnosis has been confirmed again by pathological study.

Analyzing these cases, we would say that the patient reported first in this group has probably only a short time to live, the second patient had an unusual type of myeloma which may never affect the bones, the third patient probably is not cured, the condition is merely temporarily arrested. The same may be said of the fourth patient, the fifth and sixth patients undoubtedly have true multiple myeloma of exceptionally long duration, 5 years and 8 years, respectively.

TABLE II — SEX AND AGE DISTRIBUTION

	Cases
Males	63
Females	23
Total	86
Average age (men)	52
Average age (women)	49.6
Youngest patient (boy)	4
Oldest patient (man)	75
Duration of disease from onset—	
4 months to 52 years average 26.9 months	

There are not sufficient laboratory data available in this group to make any tabulations worth while. The last 2 cases are of principal interest because of the apparently long duration of the disease. It should be noted that of these 6 cases only one had Bence-Jones proteinuria. Both of these patients received considerable roentgen therapy which may account, in part, for their prolonged existence.

In summarizing the findings in our entire group we have tabulated the incidence of the disease according to sex and age with the duration of the disease (Table II). The average duration of the disease 26.9 months, approximates the average for the subgroup of proved cases, 26.8 months. Table III is a summary of the data concerning constituents of the blood, some of which are reputed to be of help in the diagnosis of multiple myeloma. Although there are many variations from the normal among these findings it is doubtful that any can be considered more than a help in making the diagnosis.

As we have said before Bence Jones proteinuria, although suggestive was present in only 51 per cent of the entire group of cases. Most of the other findings of significance point toward renal damage which is probably present in all cases before death ensues. It cannot be said that such renal damage is always caused by the excretion of Bence Jones protein by the kidney because we have evidence of renal damage in at least 61 per cent of the cases whereas Bence Jones proteinuria was found in only 51 per cent of the cases.

The albumin globulin ratio does not seem to be a test on which much reliance can be placed because, in our series, the ratio was

TABLE III—SUMMARY OF DATA CONCERNING CONSTITUENTS OF BLOOD IN ENTIRE SERIES

Investigation	Number of estimations	Result	Normal findings
Albumin globulin ratio	9	Reversed $\frac{C}{S}$	1.5 to 3.1
Cholesterol index	4	All normal	55-65 vol % (adult) 40-50 vol % (children)
Blood cholesterol	6	All normal	570-62 mg %
Urea	4	Elevated 75	2-4.5 mg %
Blood calcium	3	Reduced	60-100 mg %
Blood calcium	3	Elevated 90	9- mg %
Blood phosphorus	11	Elevated 9	3.4 mg %
Blood phosphorus	3	Elevated 23	5-10
Urea nitrogen	3	Elevated 5	3-5 mg %
Urea protein	5	Elevated 4	6-8 mg %
Blood urea	15	Elevated 21.6	2-4 mg %
Sedimentation rate	7	Elevated 7	Less than 2 mm per h
Blood cell count	7	Elevated 4.8	mc %

Three of these are not listed Group A

reversed in only 50 per cent of the cases and in the series of proved cases none were positive although only three estimations were made. The same may be said of calcium phosphorus phosphatase and the determination of basophilia or eosinophilia all of which are not consistently changed.

PROGNOSIS

Although there are patients alive 3 and 8 years respectively after the onset of the disease the outlook for these patients who have involvement of the bone is uniformly poor. In 1 case in this series involvement of the soft parts only may be cured but sufficient time has not elapsed since the operation to make any such statement valid. All patients who have involvement of the bone however if most certainly may be expected to die from this disease.

In spite of the statement by Coley that the prognosis in multiple myeloma is by no means so hopeless as is universally believed we have found little in the study of this series of cases to make us change our view from that expressed by Meyerding regarding the ultimate fate of these cases. Without doubt in some cases roentgen therapy may prolong the life of patient but in many instances it seems ineffective, perhaps because the disease is so

widespread when treatment is commenced. In one instance in the series the initial lesion was cleaned out thoroughly and was treated with radium but without any apparent arrest of the disease. The prognosis therefore may be said to be uniformly poor but in some cases the disease tends to be more or less arrested by the use of roentgen therapy.

The application of therapeutic measure in the treatment of multiple myeloma is doomed to failure from the beginning. Undoubtedly however in a large number of cases an apparent temporary recovery has occurred from the use of roentgen therapy and tonic remedies. Although not absolutely characteristic these periods of temporary improvement with remission of symptoms both subjective and objective are an interesting feature of this disease. In some of our cases an apparent osseous recovery has been demonstrated roentgenographically, that is union of a pathological fracture has been observed with as well as apart from treatment. In reviewing all our cases we have gained the clinical impression that with the use of roentgen therapy many of our patients have experienced considerable temporary alleviation of their symptoms but we are very doubtful that life is prolonged to any appreciable extent by this method.

In summarizing the diagnostic facts regarding myeloma, the average patient is near or past middle age and complains of severe pain in the back usually of a few months duration. On roentgenological examination there is found some evidence of involvement of one or more vertebra; the roentgenographic appearance may be characteristic that is giving evidence of small punched out areas. The same type of involvement occurs in the bones of the skull. Bence Jones proteinuria might or might not be found as well as other changes noted in Table III mostly pointing toward some renal damage. However we would again emphasize the fact that there are many variations from this more or less classic picture and that the final diagnosis in many cases can be made only by biopsy which seems to us justified in cases in which there is sufficient reason to suspect the presence of the disease.

REFERENCES

- 1 BANNICK E G and GREENE C H Renal insufficiency associated with Bence Jones proteinuria report of 13 cases with a note on changes in serum proteins Arch Int Med 1929 44 486-501
- 2 BENGE JONES H On a new substance occurring in the urine of a patient with mollities ossium Phil Tr Roy Soc Lond 1848 pp 55-62
- 3 COLEY W B Multiple myeloma Ann Surg 1931 93 77-80
- 4 DALRYMPLE On the microscopical character of mollities ossium Dublin J M Sc 1846 2 85-95
- 5 KÄHLER O Zur Symptomatologie des multiplen Myeloms—Beobachtung von Albumosurie Prag med Wchnschr 1889 14 33 45
- 6 MAGNUS LEVY A Ueber die Myelomkrankheit III Vom Stoffwechsel 1 Die Bence Jones Proteinurie Ztschr f Klin Med 1931-1932 119 307-362
- 7 MEYERDING H W Multiple myeloma Radiology 1925 5 132-144
- 8 REISTZKA J von Multiples Myelom Deutsch Ztschr f Chir 1873 3 162-172
- 9 SLAVENS J J Multiple myeloma in a child Am J Dis Child 1934 47 821-835
- 10 WATKINS Personal communication to the authors
- 11 WRIGHT J H A case of multiple myeloma Johns Hopkins Hosp Rep 1900 9 359-366



Fig. 3 This shows the steps in the placing of the inner rows of sutures. A shoe maker's type of suture is used in the posterior row and a Connell suture in the anterior row. Both sutures are hemostatic and approximate serosa to serosa.

Technique of Gastrojejunostomy Using a Crushing Clamp—Thomas G. Orr

CLINICAL SURGERY

FROM THE UNIVERSITY OF KANSAS HOSPITALS

TECHNIQUE OF GASTROJEJUNOSTOMY USING A CRUSHING CLAMP

THOMAS G. ORR, M.D., F.A.C.S. Kansas City, Kansas

THE stomach and jejunum are approximated by rubber shod hemostatic clamps. The first row of seromuscular sutures of fine silk are placed as interrupted or continuous Lambert sutures. This

suture line should be about 7.5 centimeters long. If a continuous suture is used a "switchback" stitch is made every second or third suture for firm fixation. When this suture is completed the needle end is concealed beneath the wound draping to be used later for the anterior seromuscular suture.

Stab wounds are made in the stomach and jejunal walls about 0.5 centimeters from the side and 1 centimeter proximal to one end of the suture line. The stab wounds are made just large enough to admit the blade of a medium sized Payr clamp. The full thickness of the stomach and jejunal walls are crushed a distance of about 5 centimeters parallel to and 0.5 centimeters from

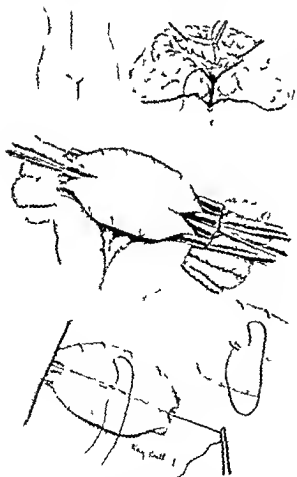


Fig. 1. The first steps in the operation are shown including location of abdominal incision, suture of mesocolon to posterior stomach wall, application of rubber shod hemostatic clamps, and first seromuscular continuous suture.



Fig. 2. Stab wounds are made in the walls of the stomach and jejunum through which a Payr clamp is passed to crush the walls along the line of incision. The stomach and jejunum are opened with scissors along the midline of the crushed tract.

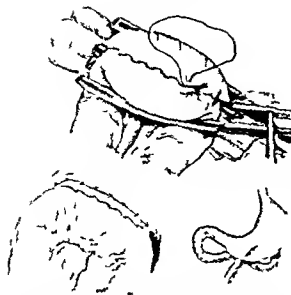


Fig. 4 The hemostatic rubber shod clamps are loosened before the anterior seromuscular sutures are inserted. Suture of the mesocolon to the stomach and the position of the gastrojejunostomy stoma are shown.

the suture line. The crushed tract is divided along its midline with scissors. The openings in the stomach and jejunum have sealed margins as a result of agglutination of the tissues by the crushing clamp.

Through and through sutures of the shoemaker's type are then placed as the second or inner row. Every second suture is tied to add security to the closure. This suture approximates serosa to serosa and is hemostatic. No. 6 chromic catgut with a needle swaged on each end is used. The anterior inner row of sutures are placed by the Connell method. This also approximates serosa to serosa. The silk suture is picked up and the anterior seromuscular row of sutures is placed in the same manner as the posterior.

The use of the Pavr crushing clamp agglutinates the tissues permitting a clean cut wound, minimizes oozing, makes excision of redundant jejunal mucosa unnecessary, and permits accurate approximation of serosa to serosa without difficulty. The Pavr clamp may also be used in like manner in other types of intestinal anastomosis.

The accompanying illustrations show the steps in technique.

TECHNIQUE OF OSTEOPLASTIC CRANIOTOMY

LAMBERT ROGERS, MSc FRCS FACS FRACS Cardiff Wales

OSTEOPLASTIC craniotomy is nearly 50 years old for it was on November 23, 1889 that Wagner of Konigshuette first performed the operation of turning down an osteoplastic flap from the skull of a young man unconscious as the result of a head injury. Supratentorial intracranial lesions are now generally approached through an osteoplastic flap and occasionally a similar method of approach is employed for suboccipital lesions also. The advantage of the method is that if a sufficient large flap is designed ample access is afforded and its subsequent replacement restores the continuity of the skull completely (Fig. 1). When ever possible the flap is designed so that its base lies in the temporal region and hinges on the temporal muscle, then if it is subsequently decided to leave a bone opening for decompression this can be placed beneath the temporal muscle.

INDICATIONS

The operation is undertaken to explore the intracranial contents with the object of carrying out surgical procedures on the cortex, the cerebral vessels or the choroid plexuses, the removal of, or other treatment of tumors and occasionally also for the drainage, decompression or removal of abscesses. The operation here described is for an intracranial tumor.

PRELIMINARY VENTRICULOGRAPHY

Many cases require ventriculography for the exact localization of the lesion and as a rule this is carried out immediately prior to the craniotomy, the site of which is then determined by inspection of the wet x-ray films which are brought to the theater with the return of the patient from the radiographic department. Any risk which ventriculography may involve is appreciably diminished if the craniotomy is proceeded with immediately.

DANGERS AND POSSIBLE COMPLICATIONS

Special equipment is necessary (endothermy apparatus, perforator and burrs, craniotome,* hot

*The Gough wire saw is used in many clinics but in the Surgical Unit at Cardiff we use an electrically driven craniotome, the skull plough.

saline stream, suction, silver clips etc.) and the employment of a specialized technique which can be but outlined here. It is essential to proceed gently, and deliberately, scrupulously guarding the patient against the loss of blood and the tissues from heavy retraction or rough manipulations of any kind. Blood pressure and pulse tracings are made every 5 minutes and recorded on a board for the ready inspection of the operating surgeon so that the condition of the patient is observed and recorded throughout the operation. Rectal saline is given during the operation by a slow drip through a fine rubber catheter. Rigid asepsis is particularly necessary since the operation may last some hours during which the exposed field may easily be contaminated. To touch on only one point of this aspect, the whole theater staff wear non penetrable masks which include the nose and so deviate the air current from the field in front of them rather than gauze which even in many layers is a poor filter for arresting organisms.

The dangers of the operation to be avoided are chiefly hemorrhage and rough handling which may lead to shock and an alarming fall in blood pressure. Blood transfusion may be required during the later stages of the removal of a tumor or other lengthy intracranial procedure. After the completion of the operation the chief danger is bleeding beneath the bone flap which may lead to the patient becoming stuporose or comatose from clot compression and necessitates his return to the theater for elevation of the flap and evacuation of the hematoma. Postoperative hyperpyrexia (e.g. 107 degrees F), particularly liable to arise after operations in the subthalamic region, calls for ventricular tapping and cold sponging.

TECHNIQUE

Preparation of the patient. The case being one of suspect tumor the patient (who has previously been dehydrated by magnesium sulphate (6 drachms per oz.) given 6 hourly by rectal administration for some days beforehand, and who during this time has also had 10 grains of hexamine given thrice daily) has the head completely shaved and the scalp surgically cleansed by wash



Fig. 1 Bone flap cut by skull plough replaced in position after the removal of a Sylvian fissure meningioma. Three silver clips can be seen and some large vascular channels in the bone.

ing with ether soap and the application of spirit. Ventriculography¹ is then performed and a decision is reached regarding the position of the lesion.

Position of patient and anesthesia. The patient is placed with the head supported on a small circular outrigger and fixed with strapping with the side of the head uppermost. Supports and towels are then arranged to shut off the rest of the patient and leave the mouth and nose free. Behind this screen of towels the anesthetist or his assistant records the blood pressure and pulse readings. It is only rarely (e.g. when it is not possible to obtain the collaboration of the patient as may happen in some cases of frontal tumor) that either or some other form of general anesthetic is required. Local analgesia by procaine (1 per cent) with 5 drops of adrenalin per ounce is used for most cases, the scalp being widely infiltrated with this solution.

The scalp flap. A flap is fashioned so that when turned down there will be an adequate area of the skull from which to fashion the bone flap and at the same time the scalp incisions are designed so that they lie entirely within the hair line and the forehead is therefore not subsequently scarred. This may necessitate the cutting of a scalp flap which is a good deal larger than the proposed bone flap, e.g. in order to cut a frontal bone flap for approaching the hypophysis the incision may need to pass from the top of one pinna almost to that of the other side (Figs. 2, 3, 4). The design



Fig. 2 Scalp incision for approach to the pituitary region. The bone flap was cut with the skull plough and a suprasellar cyst (the size of a golf ball) removed.

of the flap having been decided upon it is cut bloodlessly, the vessels on one side of the incision being controlled by pressure from the surgeon's free hand, those on the other side by the pressure of the hand of an assistant. Small artery forceps are then applied close together to the cut edge of the epicranial aponeurosis (galea aponeurotica) which is everted by them toward the wound edges. The forceps are then collected up into bundles and kept neatly together by means of rubber bands placed round their stems and handles. The incision through the scalp goes tight down to the pericranium.

The bone flap. This is cut with the skull plough (Fig. 5); an electrically driven craniotome¹ after burr holes have been made through which to introduce the dura guard and separator attached to the instrument. It will be seen (Fig. 1) that a minimal number of burr holes is necessary and the base of the flap cracks along a straight line since this terminates in saw cuts.² The flap is cracked across the base and reflected outward on its attachment to the temporal muscle.

Any bleeding from the bone flap edges is controlled by pressing warm Horsley swabs into them. In the case of some tumors (e.g. meningiomas) the bone may be extremely vascular because of the presence of large diploic channels (see Fig. 1). Bleeding from these however is easily controlled

It is to be noted that the technique of the procedure is most important in the case of the removal of the tumor. The design of the flap is such that it can be turned down and the bone flap can be cut with the skull plough. The design of the flap is such that it can be turned down and the bone flap can be cut with the skull plough.

Int. J. Surg. 93, 8, 31
N. J. R. N. M. B. 35, 93



Fig 3 Scalp incision and position of bone flap cut with skull plough¹⁾ for removal of pituitary tumor. In this case the tumor was a chromophobe adenoma.

if the skull plough is used, because as the bone is rapidly divided the saw cut is filled with wax which is pressed into it. If the method employed in some clinics of passing guides and using wire saws is followed, blood loss may be considerable under these circumstances.

Methods of dealing with tumor. The operation of osteoplastic craniotomy which in this sense may be compared with laparotomy is merely the prelude to what may be a lengthy and intricate procedure necessary for the removal of a tumor or for some other purpose which cannot be considered in this article, concerned only with the technique of the flap operation. In the present case, a woman aged 43 years for 3 years had had frontal headaches, attacks of vomiting and recently had noticed her sight becoming dim. The optic discs showed choking proceeding to secondary atrophy. There was no muscular weakness. A large space-occupying lesion occupied the right cerebral hemisphere since ventriculography showed that the whole ventricular system was considerably displaced toward the left side of the skull. Through a right osteoplastic supratentorial craniotomy, a Sylvian fissure meningioma was removed after several hours work with the endothermy apparatus the use of wet saline cotton wool pledgets and gentle teasing away and separation of the lesion.

Closure. On the completion of the intracranial operation the bone flap is replaced entire except when a subtemporal decompression is required in which case its base is removed by nibbling forceps. In many cases particularly pituitary tumors a small glove drain leading down to the operation

field is led out through one of the burr holes at the edge of the flap. This drain is usually removed on the third or fourth day. The cut edges of the dura are drawn against the bone with fine silk sutures to obliterate any space in which clot may subsequently collect and the bone flap is secured in position by perforating its edges at two or three places corresponding to similar perforations made in the surrounding bone. Fine silk sutures are then passed through these openings and tied in position. The scalp flap is then replaced, its surface and the surrounding skin when exposed being at once wiped over with gauze soaked in spirit because of possible contamination from the sweat glands. The epicranial aponeurosis is approxi-



Fig 4 Lateral view of bone flap shown in Figure 3

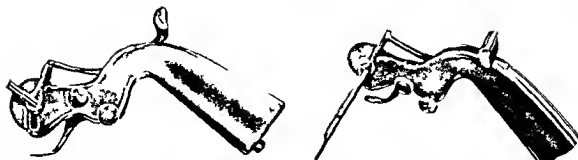


Fig. 3. Side view of skull plough at left and at right view from above and to the side (Courtesy Brit J Surg 1030 18 221)

mated with a series of interrupted fine silk sutures and the scalp edges with similar sutures of waxed thread. A dressing of gauze wrung out of spirit is applied and fixed in position with a head (cape line) bandage.

AFTER TREATMENT

The edema which is liable to follow the intracranial manipulations is checked by continuing the rectal magnesium sulphate administration already referred to while the fluid intake by mouth is limited. The patient's head is propped up on pillows to lessen venous congestion and hexamine by mouth is continued. Pulse and temperature are watched and drowsiness or

hyperpyrexia particularly looked for and dealt with in the manner already referred to. The dressing is left undisturbed for 3 days unless bleeding or discharge from drains necessitates its earlier changing or replacing. On the third day it is replaced by a fresh one of sterile gauze. On the fourth day alternate scalp sutures are cut. On the fifth the remainder. On the sixth the first lot are removed. On the seventh the second lot. In this way injury to the suture line is minimized and by the end of a week all sutures have been removed. Dependent upon the condition for which the intracranial operation is performed the rectal magnesium sulphate may be stopped in 4 days time or continued for a week or longer.

AN OPERATIVE TECHNIQUE FOR THE TREATMENT OF VESICOVAGINAL AND URETEROVAGINAL FISTULAS

W W SCOTT M D F A C S and KARL M WILSON M D, F A C S
Rochester New York

AS the result of improved obstetrical methods the incidence of vesicovaginal and ureterovaginal fistulas following parturition has materially decreased. However, these lesions still occur following childbirth and gynecological operations and, when they do they present just as serious problems in their treatment as was formerly the case. One has but to study the history of the development of the operative procedures used in the treatment of the vesicovaginal fistula so well presented by Norman Miller in order to appreciate the difficulties and disappointments accompanying surgical efforts to correct this condition.

The successful repair of vesicovaginal and ureterovaginal fistulas depends upon a number of factors. The choice of an operative procedure should be governed almost entirely by the findings in each case. Kelly in 1906 reported from the literature 11 different surgical approaches for the cure of vesicovaginal fistulas alone. Of these only 4 are now considered acceptable. It is necessary to remember that these patients should not be operated upon too soon after the injury is sustained. In some cases it is necessary to wait 3 or 4 months before attempting closure. During that time measures to make the future field of operation as healthy as possible should be instituted. These may consist of hot baths, douches, vesical lavage, and urinary antiseptics. Other factors that may prevent the successful repair in these cases are the presence of poor tissue due to excessive scarring and unsatisfactory blood supply, too much tension on sutures resulting from unsatisfactory mobilization of tissues, infection, and failure to keep the operative site as dry as possible after operation.

A review of the literature on the operative treatment of these lesions as well as the pre-operative and postoperative care of patients would seem to indicate that very little that is new could be suggested. In surgery it occasionally happens that some very essential step in surgical technique or in the preparation and care of the patient has been tried and discontinued because of failures

that were due to other factors, that either were not recognized or were beyond the surgeon's control at that time. Unfortunately, the true worth of the procedure that was mistakenly discredited may not be appreciated again until long after the factors that actually caused failure have been recognized and corrected. For example, it seemed to us that in view of the fact that we routinely placed our patients on their abdomen following operation, it would be advisable to tie up their bowels to guard against soiling of the wound and to prevent any trauma of the repaired area that might result from straining at stool. Little or no emphasis on the importance of this procedure is found in the more recent articles on this subject, and yet in 1852 we find that its value was stressed by J. Marion Sims. In those patients in whom the vaginal approach seemed indicated it seemed to us that the operation might be made less difficult if an instrument, such as the Freiberg seminal vesical tractor (Fig. 2) were passed through the fistulous vaginal opening to the bladder so that by traction the operative field could be brought into better view and a cuff of mucosal tissue could be better dissected by working against the open blades in the bladder.

Inasmuch as we have introduced some modifications in the operation for the repair of the vesicovaginal and ureterovaginal fistulas and have made use of certain procedures in the preparation and care of the patient, which have received little or no recent mention and which we believe contributed materially to the very satisfactory results obtained we feel justified in reporting the following cases somewhat in detail.

CASE 1. C S S M H No. 118474 aged 28. The patient was first seen on November 30, 1936, 12 weeks after the birth of her first child. The labor had been a difficult one, terminated by the application of forceps. The baby was large, weighing 10½ pounds. Practically complete incontinence of urine had been present since that time. Examination revealed a vesicovaginal fistula, nearly 1 cm. in diameter, which on cystoscopic examination was found to be close to the vesical orifice and adjacent to the sphincter. A roentgenogram of the pelvis showed a widening of the left sacro iliac joint as well as separation of the symphysis pubis. Both ureters were observed to function satisfactorily and neither was involved in the injury. The condition of the tissues was not satisfactory for repair at

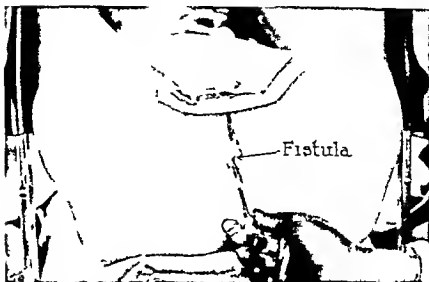


Fig. 1. Patient in position on Young table. Ureteral catheters fixed in place. Note splendid pre-entation of fistula for vaginal repair operation.

this time so she was discharged and readmitted 3 months later. During this interval the incontinence of urine persisted and unfortunately she had developed a suicidal complex as a result of it. It was therefore of the utmost importance that the operative procedure be followed by a successful result.

In preparation for operation the bowels were thoroughly cleared, she was given daily bladder irrigations for 4 days prior to operation, and vaginal douches of Dakin's solution twice daily. The day before operation ureteral catheters No. 7 F. were passed to the kidneys and left *in situ*. As we proposed to keep the patient lying in the prone position for some days after operation, she was kept in this position for several hours each day before operation in order to accustom her to it.

Operation was carried out by vaginal approach. For any such vaginal operation position of the patient to permit proper exposure is a matter of some importance, though often the position used may be determined by the personal predilections of the operator. Thus the Sims position, the knee-chest, the inverted Trendelenburg, and the exaggerated lithotomy positions have been the positions most frequently employed for operation. The exaggerated



Fig. 2. The Freiburg seminal vesical tractor with blades opened and closed.

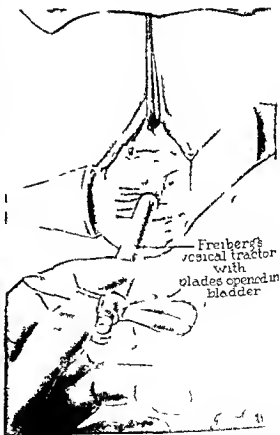


Fig. 3. Freiburg's seminal vesical tractor introduced through opening of fistula and blades opened in bladder.

lithotomy position as employed by Simon in the 1860's is infrequently used today but in our patient it appeared to offer the best exposure. To obtain and maintain this position we used the Young prostatectomy table with great satisfaction (Fig 1).

In order to obtain still better exposure and at the same time to obtain counter pressure while the necessary dissection was carried out, Freiberg's seminal vesical tractor (Fig 2) was inserted into the fistula, the blades were opened and moderate traction was made on the handle (Fig 3). This procedure reverses that suggested by Young for improving the exposure of the operative area in the transvesical approach to vesicovaginal fistula. In this instance it proved to be of great help and undoubtedly made the subsequent steps much easier of execution. An excellent exposure of the fistula was obtained by making moderate traction on this instrument. A circular incision was then made through the vaginal mucosa approximately 1 centimeter from the margin of the fistulous tract (Fig 4). By further dissection the fistulous tract was freed from the muscle wall of the bladder down to the bladder mucosa. A pursestring suture of No. 1 chromic catgut was placed in the base of the fistulous tract (Fig 5 a). After this suture had been placed the blades of the tractor were closed and the instrument removed. The fistula was then inverted and the pursestring suture was firmly tied (Fig 5 b). By further dissection the vaginal mucosa was freed from the underlying bladder wall until the edges came together easily and without tension, such scar tissue as was present being excised. The edges of the bladder muscular wall were sutured with interrupted No. 1 chromic catgut sutures (Fig 5 c). After a small amount of redundant vaginal mucosa had been excised the vaginal wound was closed by a continuous No. 1 chromic catgut suture; this suture line being at right angles to the underlying suture line in the bladder wall (Fig 6 a and b). This step completed the operation.

In order to keep the operative site just as dry as possible the urethral catheters which had been passed the day before

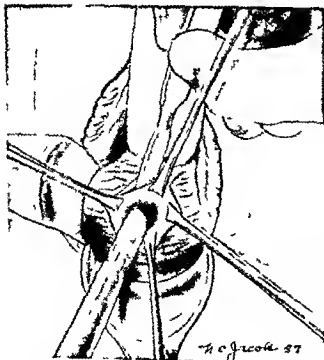


Fig 4 The dissection of the mucosal cuff of the fistulous tract. Traction being made by the seminal vesical tractor.

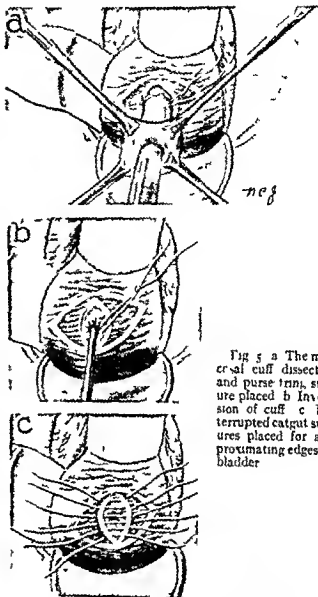


Fig 5 a The mucosal cuff dissected and purse string suture placed b Inversion of cuff c Interrupted catgut sutures placed for approximating edges of bladder

operation were left *in situ* and to provide drainage for such urine as might leak into the bladder around these a No. 18 F. urethral catheter was passed and all 3 held in position by silk sutures.

The patient was placed in the prone position and this was maintained for 12 days. In order to prevent undue physical effort and also the possibility of soiling of the operative site she was placed on liquid diet and the bowels were not allowed to move during the time she was kept in the prone position. It had been planned to leave the urethral catheters in place for 6 days, but the left one became blocked on the fifth day and was removed; the right one was removed the following day. The urethral catheter was left in the bladder during the time the prone position was maintained. Urinary antiseptics were administered during this time.

The convalescence was entirely satisfactory and perfect healing of the operative site resulted with complete urinary control.

CASE E D S M H No 134530 aged 50. This patient developed a large vesicovaginal fistula following cauterization of the cervix and the repair of a cystocele. Four months later on April 27, 1938 she entered the hospital for operation. On examination a large fistula was

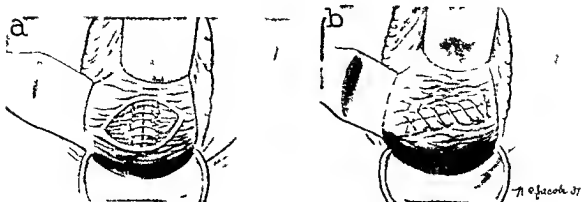


Fig. 6. a. Closure of bladder wall. b. Approximation of mucosal surfaces of vagina.

from 10 to 12 cm. to the cervical orifice and slightly to the left of the midline. The patient was treated in a manner identical to that described in the previous case with equally satisfactory result.

CASE 3. S. D. S. M. H. No. 120920 aged 47. In April 1931 the patient was operated upon elsewhere for fibroids of the uterus. The ovarian tube and uterus including the cervix were removed. She reported that she was severely ill immediately following her operation and for several weeks afterward. Three days after the operation she began to drain all of her urine through the vagina.

She was first seen in the clinic on July 14, 1931. Aside from moderate cardiac enlargement and a systolic murmur her physical findings were essentially normal except for the bladder and vagina. The vaginal mucosa was red and inflamed and in the vault on the anterior wall and rather far to the right of the midline was a small patch which was assumed at that time to be granulation tissue. About 3 centimeter below this point and a little to the right of the

midline was the opening of a vesicovaginal fistula about 1.5 centimeters in its greatest diameter. On cystoscopic examination a vesical calculus 1.5 centimeters by 1 centimeter was found and removed. It was difficult to dilate the bladder because of the fistula. The bladder mucosa was markedly inflamed and congested. The left ureter was easily catheterized. The opening of the vesicovaginal fistula was located about 2 centimeters above the level of the right ureter. Attempt to catheterize the right ureter were unsuccessful and at that time it was thought our difficulty was due to a stricture or a sharp angulation of the ureter due to trauma. The patient was discharged on a routine of urinary antiseptics, douches, and bladder irrigations in preparation for a repeat operation.

The patient was next admitted to the hospital in a critical condition due to acute rheumatic fever on October 25, 1931. Her course in the hospital was very stormy and she was not discharged until January 4, 1932. Her diagnosis at that time was acute rheumatic fever with carditis and myocarditis, pulmonary embolism, mitral stenosis and in sufficiency, interventricular conduction defect with left bundle branch block and ventricular extrasystoles.

On July 26, 1932, she again entered the hospital. The condition of the tissue of the vagina and bladder was markedly improved and it was found that the tuft of red tissue in the vagina previously assumed to be granulation tissue represented the vaginal orifice of a ureterovaginal fistula (Fig. 7). The patient's cardiac condition was still far from satisfactory, there was marked dyspnea, the pulse was fast and her basal metabolism in radiation was plus 40.

The suprapubic approach was selected for a number of reasons. The vesicovaginal fistula was located high in the vault of the vagina. From the location of the orifice of the ureterovaginal fistula in the vagina it appeared as though the remaining portion of the ureter would be too short to permit sufficient mobilization for transection and to the bladder through the vaginal route. Furthermore we were informed by our medical advisers that the patient's dyspnea was such that it would be impossible to lower her head sufficiently for the vaginal operative approach. On account of the dyspnea cyclopropane anesthesia was used.

Suprapubic repair of vesicovaginal and ureterovaginal fistulas with transection of the right ureter to the bladder was performed. The right ureter was catheterized through the vagina where it opened into the latter and the catheter was fixed in place as an aid in locating the lower end of the ureter from above. The patient was placed in the usual position for the suprapubic transverse approach to the bladder except for the reasons stated the head was

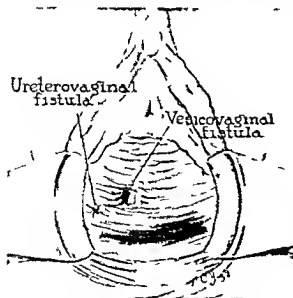


Fig. 7. Vaginal pre-entration of vesicovaginal and ureterovaginal fistulas.

not lowered. A midline incision was made and the bladder was exposed and opened. Although it was a little difficult because of the patient's position and the previous operation with its subsequent infection, the peritoneum was separated from the bladder and held out of the way by packs. The lower end of the right ureter was mobilized sufficiently to reimplant in the bladder without too much tension and then freed from the vagina at its point of attachment and the ureteral catheter was drawn out from below. The vaginal opening was closed from above with interrupted No. 1 chromic catgut sutures care being observed to invert and approximate the vaginal mucosal surfaces. The line of cleavage between the vagina and bladder was easily developed, the vesicovaginal fistula was isolated and cut across and the dissection carried well below its point of attachment to insure full mobilization of the vagina and the base of the bladder. The mucosal surfaces of the vaginal wall were inverted into the vagina and the opening was closed by interrupted No. 1 chromic catgut sutures. The mucosal surfaces of the bladder portion of the fistula were inverted into the bladder and approximated by a continuous suture of No. 00 chromic catgut. The musculature of the bladder was closed by interrupted sutures of No. 2 chromic catgut placed at right angles to those inserted in the vagina. As a result of placing the sutures as described and the liberal mobilization of the bladder and vaginal walls, the repaired areas in both organs were no longer in contact with each other. A No. 7 F ureteral catheter was then passed up the right ureter to the kidney and the very tip of the severed ureter was tied firmly to the catheter. A small stab wound was made in the posterior wall of the bladder at a point where the ureter could be implanted with the least tension and the catheter and the ureter were drawn through the opening into the bladder. After the reimplanted ureter was fixed to the bladder by 3 No. 00 chromic catgut sutures the ligature attaching the ureteral wall to the catheter was cut. A No. 7 F ureteral catheter was passed to the left kidney pelvis and the ends of both catheters were passed through the urethra and fastened in place with silk sutures. The bladder was closed about a mushroom catheter placed suprapubically and the space of Retzius was drained by a small tube and a cigarette drain. The customary closure for wounds of this character was made. The patient's condition was fair at the end of operation.

Upon return to the ward the patient was placed on her abdomen on a Bradford frame to facilitate drainage and prevent the puddling of any urine that might drain around the ureteral catheters. The same postoperative routine previously described in the care of Case 1 was followed. The ureteral catheters were removed in 7 days and in 21 days she was removed from the Bradford frame and placed on her back. The small suprapubic catheter that was draining the bladder at this time was removed and a small urethral catheter was placed to hasten healing. The suprapubic wound re-opened once following the removal of the urethral catheter. The patient's convalescence was slow because of her very poor general condition. Five weeks after operation she suffered a severe attack of rheumatic fever with marked accentuation of her cardiac symptoms and enlargement of her joints, the right knee joint being especially involved. It was 4 weeks before she had recovered sufficiently from this attack to be discharged from the hospital. The implanted ureter was dilated 12 weeks after operation and a normal pyelogram was obtained. The

vesicovaginal fistula healed *per primam*. A retrograde study of the right kidney and ureter was made 13 months after operation and they were found to be normal.

SUMMARY AND CONCLUSIONS

The successful pre operative and postoperative routine as well as operative technique employed in the repair of vesicovaginal and ureterovaginal fistulas is presented.

In no surgical condition will the meticulous attention to detail the operative technique, and the pre operative and postoperative care of the patient pry greater dividends in the way of good results than in the treatment of vesicovaginal and ureterovaginal fistulas. This small group of cases is presented to emphasize this point and while the technique presented suggests no marked fundamental changes we believe that the accessory procedures employed during and after the operative care of these patients did contribute materially to the satisfactory results obtained.

We would emphasize the value of the special tractor in facilitating the necessary dissection. This instrument in its present form could be used only in the case of the large fistula, but a modification of it could be adopted to those of a much smaller size. Keeping the operative site just as dry as possible is of the greatest importance during the healing process. The prone position facilitates this as does also the use of ureteral catheters in addition to the usual lying urethral catheter. These may be left *in situ* for as long as 8 to 10 days if it seems desirable. In using ureteral catheters every effort should be made to prevent renal infection. Oral urinary antiseptics should be started as soon as possible after operation.

Keeping the patient on a slight residue diet and preventing evacuation of the bowels for 10 to 12 days, reduces the handling of the patient which would otherwise be necessary and also reduces the possibility of the contamination of the operative site. The operator should be guided in his choice of procedure by the finding in each case. The patient should be instructed to refrain from sexual intercourse for at least 3 months after operation.

REFERENCES

- 1 KELLY HOWARD Tr Am Gynec Soc 1906 31 225
- 2 MILLER NORMAN Treatment of vesicovaginal fistulas Am J Obst & Gynec 1935 30 675-695
- 3 SIMS J MARION Am J M Sc 1852 23 59
- 4 YOUNG and DAVIS Practice of Urology 1926 Vol 2 p 382
- 5 YOUNG H H Surg Gynec & Obst 1927 45 226

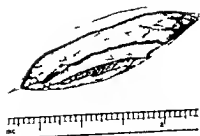
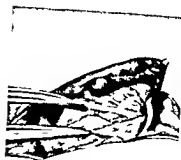


Fig 1



Fig 2



Fig

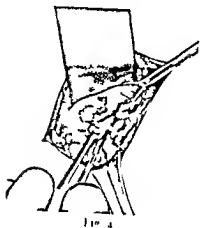


Fig 4

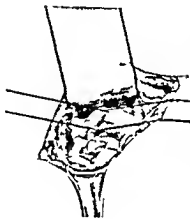


Fig 5

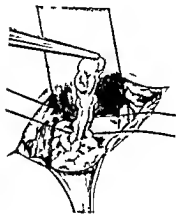


Fig 6

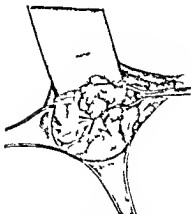


Fig 7



Fig 8

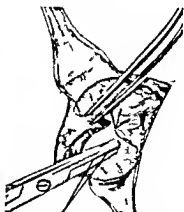


Fig 9

Fig 1 The skin incision 2/ to 3 inches long made transversely in the general direction of the fibers of the transversalis

Fig 2 Median half of anterior rectus fasciculus cut across

Fig 3 The right rectus muscle is pulled laterally and the fibers of the transversalis muscle are exposed. Here they are thinned out as a fascial plane and fused with the

peritoneum. This layer was incised transversely in direction of the fibers and the margins grasped with hemostats

Fig 4 The duodenum has been picked up with a Babcock forceps and retracted to the left. The liver is held up with a Deaver retractor. The thumb forceps is grasping a tag of the gastrosplenic omentum

(Balance of legends on opposite page)

*Acute Perforated Peptic Ulcer Simple Closure Through a Short Transverse Incision —
John B. Hartell and Milton L. Sorock*

ACUTE PERFORATED PEPTIC ULCER

Simple Closure through a Short Transverse Incision

JOHN B. HARTZELL, M.D., F.A.C.S., and MILTON L. SOROCK, M.D. Detroit, Michigan

THERE has been a recent revival of interest in the advantages offered in the use of the transverse type of incision in abdominal surgery. In general the transverse incision possesses the definite anatomical advantage in preserving the nerve and blood supply of the abdominal muscles. There is another important factor which is frequently overlooked, namely the preservation of the fibers of the transversalis and internal oblique muscles which are severed in the vertical incision. This point has been stressed by Quam, Sloan, Batson, Singleton, Hartzell and Winfield and also recognized by Clute, Pool, Lynn, Meleney and Howes, and others.

The simplified approach to ruptured gastric and duodenal ulcers through the small oblique incision as described by Amendola, appeared to have decided merit. During the past year, we have used this incision in a slightly modified form in 39 cases.

We make our incision more horizontally than does Amendola, starting in the midline about 2 inches below the costal border (if possible always at, or just below the liver border and extending $2\frac{1}{2}$ to 3 inches to the right). The incision is carried through the skin, subcutaneous tissue and the anterior fascia of the rectus muscle. The muscle is then freed from its sheath for a short distance and retracted laterally. The fibers of the transversus abdominis muscle and the peritoneum

are split transversely, a finger is inserted, and usually the ulcer is easily palpated. Most frequently it is felt to the right of the incision. If the liver is low, it may be elevated out of the way with a Deaver retractor. The duodenum is grasped with a Babcock forcep and retracted to the left. If the operator now stands on the patient's left side, he will usually look directly downward upon the perforation, which is easily closed as shown in the illustration. Rarely this incision does not afford adequate exposure, and the fibers of the rectus muscle may then be cut across and the incision extended transversely as far as the lateral border of the rectus muscle. This procedure will usually afford adequate exposure in even the most difficult cases. Although on several occasions this small incision has been extended upward from the inner angle, downward from the outer angle, while on one occasion, where the ulcer was high on the gastric wall, it was extended across the midline an equal distance, and the left rectus muscle was retracted laterally.

During the past 6 years, there have been 273 patients with acute ruptured ulcer of the stomach and duodenum operated upon at the Receiving Hospital, with 73 deaths. Two hundred and thirty-four of these were operated through vertical right rectus incisions with a mortality of 28.9 per cent. In this group of cases, there were 6 wound disruptions with evisceration, an incidence of 2.6 per cent. Three of these died. During the past year 39 ruptured ulcers have been repaired through the transverse incision, with 5 deaths, a mortality of 12.8 per cent.

We do not wish to emphasize the lower mortality in the group operated upon through the

From the Department of Surgery, Wayne University College of Medicine and the Surgical Service of Receiving Hospital, Detroit.

Fig. 5 The ulcer is closed by simple inversion. We do not hesitate to use the Graham method of closure in those cases in which a friable indurated area about the ulcer does not permit of simple inversion.

Fig. 6 A tag of omentum is tied with the same sutures. When such a tag is not available we sometimes split a graft from the ligamentum teres or use a free omental graft as described by Graham.

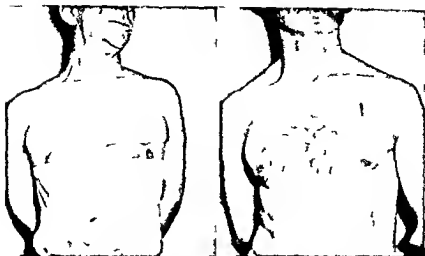
Fig. 7 Omental tag is tied in place over closed ulcer.

Fig. 8 The transversalis fascia and peritoneum (posterior rectus sheath) are closed as one layer.

Fig. 9 When lateral traction on the muscle is released the medial border returns to the midline and the anterior rectus fascia is closed.



Fig. 10 The skin margins are approximated.



Figs. 11 and 12 Healed cases 1 to 2 weeks after operation

transverse incision, as to date we have not had a sufficiently large group of cases. We believe however that this simplified method of approach has many advantages. It is easy to accomplish in the majority of cases. We have been able to operate in several cases in which patients were practically *in extremis* using local novocain injections where no attempt was made to obtain relaxation.

Quite a number of the patients develop severe wound infections and when the small incision is used even when disruption takes place evisceration or incisional hernia has not occurred. The small bowel is not visualized and consequently is not traumatized by being held out of the way in order to obtain exposure. The wound is more easily closed even in the absence of relaxation. The patient is far more comfortable and is able to move about in bed with little difficulty. The morbidity is shortened the patient is out of bed sooner usually the seventh to the eighth day and therefore is discharged from the hospital at a correspondingly earlier date.

BIBLIOGRAPHY

1. AMENDOLA F. H. Simplified approach for suture of acute perforation of peptic ulcer. *Surg. Gynec. & Obst.* 1937 64 6-77.
2. BATSON OSCAR. Anatomy of gall bladder incisions. *Surgery* 1938 3 871-874.
3. CLUTE H. M. Mattressed peritoneal sutures in epigastric lesions. *Surg. Clin. America* 1929 9 1453.
4. GRAHAM R. R. Treatment of perforated duodenal ulcers. *Surg. Gynec. & Obst.* 1937 64 235-238.
5. HARTZELL JOHN B. and WINFIELD J. Disruption of abdominal wounds. *Internat. Abstr. Surg.* 1939 68 585-601.
6. LYNN F. S. and HALL H. C. The elective transverse abdominal incision. *Ann. Surg.* 1936 104 233-241.
7. MELENEY F. L. and HOWES E. L. The disruption of abdominal wounds with protrusion of viscera. *Ann. Surg.* 1934 99 5-13.
8. FOOTE F. H. The zipper stitch for upper abdominal incisions. *Am. J. Surg.* 1931 13 225-226.
9. QUAIN ERIC C. The necessity of conserving the intercostal nerve in abdominal incisions. *Experimental study*. *Tr. West Surg. Ass.* 1913 PP 353-360.
10. SINGLETON A. O. and BROCKEN T. C. JR. Problem of disruption of abdominal wound and postoperative hernia. *J. Am. M. Ass.* 1930 112 122-127.
11. STONE G. A. A new upper abdominal incision. *Surg. Gynec. & Obst.* 1927 45 6 8-637.

PROBLEMS IN DIFFERENTIAL DIAGNOSIS BETWEEN UROLOGIC AND ABDOMINAL LESIONS

HERMAN L. KRETSCHMER M.D. F.A.C.S. Chicago, Illinois

IT is hardly necessary at this time to emphasize the importance and value of making an accurate pre operative diagnosis. Such a diagnosis enables the surgeon to plan the operative procedure, the technical steps of the operation can be carried out rapidly and as a result complications are relatively rare and the morbidity is greatly reduced.

Activities of the urologist are no longer limited to the realm of diagnosis and differential diagnosis of lesions of the genito urinary tract since he is called upon with increased frequency to aid in solving problems of differential diagnosis between lesions of various abdominal organs and the genito urinary organs. Furthermore he is called upon more frequently than formerly to solve differential diagnostic problems in the field of general diagnosis.

The urologist is confronted not only with pre operative problems of differential diagnosis between abdominal lesions and lesions of the genito urinary tract but he is frequently called upon after operation. He must be familiar therefore with the various urological complications following general surgical as well as gynecological operations.

From the urologist's point of view the problem of differential diagnosis is concerned with (1) a consideration of the various intra abdominal and retroperitoneal lesions that may be confused with urological lesions, (2) with postoperative complications in the urinary tract, (3) with complications arising from the pathological process for which the patient was operated upon, these complications being confused with lesions in the urinary tract and (4) with lesions that are not recognized until after the complications arise and which demand consideration in order to determine the cause of the patient's condition after operation.

Before entering into a detailed discussion of some of these problems it might be desirable to emphasize that here as in any problem of diagnosis great care must be exercised in obtaining the history, because from this source one very often gains valuable information that may lead to

a correct solution of the problem. Only too frequently errors in diagnosis are made because not enough time is devoted to obtaining the history or because a faulty interpretation is given to the patient's story.

LESIONS OF THE GASTRO INTESTINAL TRACT

Lesions of the gastro intestinal tract probably constitute the largest group that calls for differentiation and, of these, appendicitis heads the list. The differentiation between lesions of the urinary tract and lesions of the appendix should be relatively simple, however, the large number of patients seen by the urologist each year for the relief of urinary symptoms in whom an appendectomy has failed to effect a cure, is evidence that the differentiation is not made as frequently as it should be.

At times the differentiation between acute appendicitis and acute pyelitis is difficult, especially if a patient with an acute disease of the appendix has some red blood cells and perhaps a few pus cells in the urine and it is difficult to obtain an accurate history. In a child having acute severe pyelitis with right sided pain and tenderness the differentiation is especially difficult if the urinary findings are negative as they may be during the first 24 or 36 hours, after the urine becomes loaded with pus the diagnosis is self evident. The number of cases in which this differentiation is impossible and in whom it is necessary to perform an appendectomy is very small indeed.

This differentiation may present great difficulties in an adult female who has had severe attacks of pyelitis during one or more pregnancies. If a woman who has previously had attacks of pyelitis suddenly develops an attack of acute appendicitis it is easy to understand why the attack of appendicitis may be overlooked and the clinical picture attributed to a lighting up of an old infection in the kidney. In this type of case, if after due deliberation and consultation, it is not possible to make the differentiation one should give the patient the benefit of the doubt and operate on her rather than run the danger of overlooking an acute appendix and having the patient die of generalized peritonitis. The number

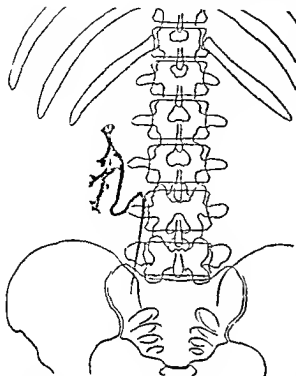


Fig. 1. Case 1. Kink in right ureter. Note absence of hydronephrosis.

of patients in whom this differential diagnostic problem arises or in whom an appendectomy is performed and in whom urinary symptoms persist constitutes a relatively small group of cases.

I now wish to call attention to a group of patients in whom no acute problem in differential diagnosis is present. I refer to the large number of patients who are operated upon for appendicitis—generally chronic cases in which the patients' symptoms persist after the appendix has been removed. Inasmuch as no acute problem is present so that no acute surgical emergency exists it would appear that there would be ample time to establish a correct diagnosis rather than subject the patient to an operation that does not remove the cause of the symptoms. Here again a careful history and physical examination coupled with a careful urinary examination would often lead to a correct diagnosis. In all doubtful borderline cases the patient should have the benefit of a complete urological survey before his so-called chronic appendix is removed.

The number of patients who consult the urologist each year for the persistence of urinary symptoms after an appendectomy is legion and we should make every possible effort to establish a correct diagnosis before operation and thereby

institute not only the correct treatment but avoid an unnecessary operation. The differentiation between lesions of the appendix and of the urinary tract cannot be overemphasized.

Among the more frequent lesions in the urinary tract that are overlooked or confused with chronic appendicitis may be mentioned chronic pyelitis, hydronephrosis with or without infection, renal and ureteral calculi and renal tuberculosis. Among the rare lesions in the urinary tract in which the underlying pathology is not recognized may be mentioned ectopia of the kidney, solitary fused kidney, and congenital polycystic disease.

At rare intervals confusion arises in the differential diagnosis between lesions of the genital tract in the male such as seminal vesiculitis and appendicitis. However, a careful review of the history is of great value as the history in acute appendicitis is quite different from that in lesions of the male genital tract. The rectal examination is most important as it gives information that generally aids in making a differential diagnosis.

LESIONS OF THE GALL BLADDER

The problem of differential diagnosis between lesions of the gall bladder and the kidney has become greatly simplified since the advent of pyelography and cholecystography. Before the advent of cholecystography the urologist was frequently called upon to aid in differential diagnosis in order to rule out lesions of the kidney in borderline cases. With the advent of cholecystography, another important diagnostic aid has been placed at our command, thus leading to more accurate diagnoses of lesions in the right upper quadrant. In a good many cases of right upper quadrant pain, pyelography or cholecystography will suffice.

There remains however a small group of cases in which the patient has a lesion both of the kidney and of the gall bladder so that at times it is difficult to state whether the symptoms of which the patient complains are due to one lesion or to both. A good deal of study may be necessary in order to determine which of the two lesions is responsible for the patient's symptoms so that the correct surgical procedure may be instituted.

Two cases under recent observation will serve as illustrations.

CASE 1. (a) Acute recurring pyelitis. (b) nephroptosis (c) cholelithiasis. Mrs. F. S., aged 38, was admitted to the Presbyterian Hospital on October 25, 1933. The previous history was irrelevant. The patient complained of pain in the right side, dysuria, difficulty on urination, nausea, vomiting and weakness. Seven weeks before admission to the hospital the patient was suddenly seized with an acute pain in the right upper quadrant which radiated down and

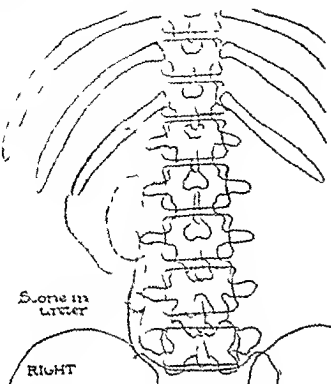


Fig. 2. Case 1. Presence of stone in the ureter, stones in the gall bladder and the lower pole of the kidney.

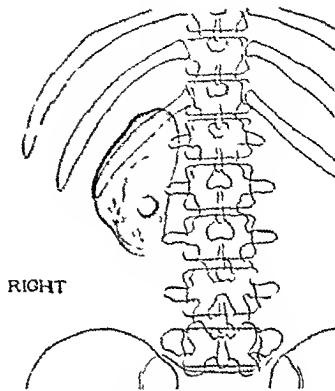


Fig. 3. Case 2. Retrograde movement of stone from the ureter into kidney pelvis. Gall and kidney stones present.

and forward as well as to the back. The pain was associated with nausea and vomiting. The pain subsided but since then there had been a persistent dull steady ache in the same area but of lesser degree. A cystoscopic examination was made elsewhere and a diagnosis of infection of the right kidney was made.

Examination of the head, the neck, the heart and lungs was negative. Examination of the abdomen revealed tenderness over the entire right side. The blood pressure was systolic 120 and diastolic 85.

Blood count showed 4,000,000 red blood cells, 7,200 white blood cells and a hemoglobin of 92 per cent. Examination of the urine on admission showed no albumin, blood or pus. A mixed phenolsulfonphthalein showed an output of 50 per cent in 1 hour. Blood chemistry examination: urea nitrogen 11.5, uric acid 3.0, creatinin 1.4, non protein nitrogen 28.8.

Cystoscopic examination revealed a normal bladder and ureteral orifices. The ureters were catheterized without difficulty or obstruction. The urines obtained from the right and left kidneys and bladder were free of pus. The urine from the right kidney was sterile on culture and urine from the left kidney showed 3 colonies of hemolytic *Bacillus coli*. Culture of the bladder urine showed hemolytic *Bacillus coli* and *Shigella*.

Konigsnegographic examination was negative for stone in the urinary tract. Shadows were seen that were compatible with multiple stones in the gall bladder. A set of intravenous pyelograms were made and they were normal except that there was a kink in the right ureter (Fig. 1). A cholecystogram showed a poorly functioning gall bladder. The patient was discharged on November 1, 1933.

In view of the fact that the patient has had many attacks of pain in the right upper quadrant

that pus and colon bacilli have been found in the urine from the right kidney at various times, the presence of a normal pyelogram associated with a movable kidney with a kink in the ureter, a rare evidence of gall stones and a poorly functioning gall bladder all led to the conclusion that the cholelithiasis was the primary underlying cause of her trouble, that the infection in the right kidney was secondary and that operation should be performed on her gall bladder and not the kidney.

CASE 2. (a) Nephrolithiasis, right; (b) ureterolithiasis, left; (c) cholelithiasis. Mrs. C. W., aged 33 years, was admitted to the Presbyterian Hospital on November 13, 1935.

A right ureterotomy and a lithotomy were performed elsewhere in March, 1937. The present illness began in August, 1935, at which time the patient had a very severe attack of pain in the right lumbar area. There was nausea and vomiting. The pain gradually subsided and completely disappeared at the end of the fourth day. During this attack the patient had no jaundice, hematuria or dysuria. On November 2 she had another attack of pain in the right upper quadrant. The patient consulted a physician and a roentgenogram was taken. She was told that she had a stone in the right kidney. The third and present attack of pain began on November 13, 1935. The pain was sudden, sharp and knife-like and began in the right flank and radiated towards the right upper quadrant of the abdomen. Nausea and vomiting were associated with the pain.

Physical examination revealed temperature 100 degrees, pulse 98, respiration 24. Examination of the head

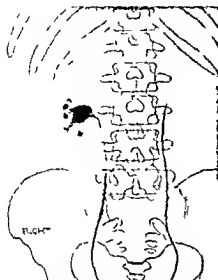


Fig. 4. Case 3. Case 1 subphrenic abscess. Displacement of kidney and liver downward.

neck, and lungs was negative. A coarse systolic murmur was heard at the apex of the heart. Examination of the abdomen revealed acute costovertebral tenderness posteriorly and marked rigidity below the costal arch on the right side in the region of the gall bladder.

The urine on a missis was normal. Examination of the blood showed 23,400 leucocytes. The phenolsulfonphthalein test showed an output of 50 per cent in 90 minutes.

Röntgen graphic examination showed a shadow in the right ureter and a small shadow compatible with stones in the inferior pole of the right kidney and a small collection of shadows compatible with stones in the gall bladder (Fig. 2). A cholecystogram demonstrated the presence of stones in the gall bladder. A second film showed the stone that was previously noted in the right ureter in the kidney pelvis—retrograde movement of stone (Fig. 3). There were several small calculi compatible with stones in the lower left ureter.

During the period of observation in the hospital the patient passed several small stones corresponding with the shadows seen in the lower left ureter. After the patient had been admitted to the ward it was difficult to interpret the clinical picture. The history of a previous ureterotomy for stone coupled with tenderness in the right costovertebral angle and pain in the back justified the diagnosis of renal colic due to stone. The marked tenderness and rigidity over the gall bladder area justified the diagnosis of a lesion of the gall bladder. After due deliberation a tentative diagnosis of both renal colic and gall stone colic was made. This was verified by roentgenographic studies.

The sudden relief of the symptoms due to the kidney can be explained by the retrograde movement of the stone from the right ureter into the kidney pelvis—a phenomenon described previously.¹ After this occurred the clinical picture was that of cholelithiasis and an operation was advised. A cholecystectomy was performed by Dr. V. C. David on November 23, 1935. The patient made an uneventful recovery and was discharged on December 7, 1935. The patient was readmitted to the hospital on January 6, 1939, and the stone was removed from the kidney on

IF t. hunc. H. m. n. L. R. t. gr. d. m. v. m. t. (st. e. th. uret.)
J. Am. M. Ass. 9:8:7: 1355

January 10, 1939. The patient was discharged on March 22, 1939.

SUBPHRENIC ABSCESS FOLLOWING PREGNANCY

Although the occurrence of chills and fever, the presence of pain in the right kidney area and pus in the urine occurring during pregnancy would seem to justify the diagnosis of pyelitis of pregnancy, one must always be on the alert for the possibility of some lesion outside the urinary tract that may be responsible for the clinical picture that may occur during pregnancy or the puerperium. As an example of a case that presented an interesting problem in differential diagnosis I should like to present the following:

CASE 3. (a) Subphrenic abscess. (b) pleural effusion. (c) pyelitis of pregnancy. (d) secondary anemia. Mrs. B., aged 25, was referred by Dr. W. C. Hoyt and admitted to the Presbyterian Hospital on October 23, 1928, with a diagnosis of pyelitis of pregnancy.

Three weeks before admission to the hospital the patient was in her eighth month of pregnancy when she began to develop convulsions and lost consciousness. She was immediately delivered of the child. The child lived 12 hours. Seven days before she was admitted to the hospital she developed severe pain in the right upper quadrant which was aggravated by breathing. At this time the patient developed severe chills and a temperature of 104 degrees. There was some frequency and burning on urination. The examination of the urine showed the presence of a large amount of pus.

The tongue was dry, pulse 120, temperature 102.6 degrees. Examination of the heart negative. The right chest was flat and the breath sounds were distant. The left chest was normal. Examination of the abdomen showed the right kidney enlarged and tender. The lower edge of the liver was 2 inch below the costal arch; the spleen was not felt. The pelvic examination was negative.

Examination of the urine revealed albumen 2 plus, blood 3 plus, and a leucocyte count of 3,500 pus cells per cubic millimeter. Examination of the blood showed 2,660,000 red blood cells, 22,900 leucocytes, and a hemoglobin of 55 per cent. The blood pressure was 160/90. The Wassermann test was negative and guinea pig tests were negative for tuberculosis.

Cystoscopic examination. Cystoscopy showed a normal bladder and the ureters were catheterized without difficulty or obstruction. Cell count showed 475 white blood cells per cubic millimeter and culture showed *Bacillus coli communis* in the bladder urine. The urine from the right kidney was free of pus and culture showed *Bacillus coli communis*. The left side showed 300 white blood cells per cubic millimeter and *Bacillus coli communis*.

Röntgenographic examination was negative for stone. The right pyelogram showed the kidney pelvis opposite the third lumbar slightly dilated with slight dilatation of the right ureter (Fig. 4). The left pyelogram was normal. Roentgenographic examination of the chest revealed the clinical findings of right pleural effusion made by Dr. F. C. Cross who aspirated 900 cubic centimeters of turbid fluid. Examination of the fluid aspirated from the chest showed no organisms on Gram stain and no tubercle bacilli were found.

This patient presented a very unusual and interesting problem in differential diagnosis. The history of chills and fever, swelling in the region of the right kidney and the

presence of pus in the urine led to the diagnosis of right sided pyelitis of pregnancy. However the low position of the liver and the presence of pus in the left kidney whereas the right was free of pus and the low position of the right kidney and the presence of fluid in the right pleural cavity led to the conclusion that the patient suffered from more than a pyelitis of pregnancy.

The patient was seen in consultation by Dr E L Irons and Dr V C David and after careful consideration a diagnosis of subphrenic abscess was made and operation advised. The patient was operated upon by Dr V C David on November 3 1928 and a subphrenic abscess was drained. Examination of the pus from the subphrenic abscess showed gram positive cocci in groups a few short chains and slender gram positive rods. The patient made an uneventful recovery and was discharged on December 11 1928.

CYST OF THE PANCREAS

As a general premise one may state that cysts of the pancreas are rare and present no pathognomonic symptoms. Physical examination reveals an elastic swelling in the epigastrium generally in the midline. The onset is slow and the nature of the disease is progressive. In the majority of cases the swelling comes forward so that it is readily palpable. Displacement of viscera may occur and, in rare instances there may be displacement of the kidney. Cysts of the pancreas may be confused with lesions of the kidney such as hydronephrosis and tumor especially when there is some displacement of the kidney.

Urological diagnostic procedures are necessary to establish the differential diagnosis. In some instances there may be hydronephrosis of a moderate degree due to pressure and in other instances displacement of the ureter, the kidney or both may occur. In one of our cases the pyelogram showed that the pelvis of the kidney was normal, and there was displacement so that it formed an obtuse angle with the ureter. As an example of a case in which it was necessary to differentiate between a lesion of the kidney and the pancreas I should like to present the following case.

CASE 4 (a) Cyst of the pancreas Mrs R H aged 23 was referred by Dr I Rabens.

The previous history was negative. The patient was a bit indefinite about the onset of her symptoms. Her chief complaint was the presence of a feeling of fullness in the upper abdomen. She had suffered from constipation for many years which was always worse a few days before and after menstruation. Menstruation was generally associated with cramp like pain in the abdomen. In addition the patient gave a history of dizziness pains in the head and nervousness.

Examination of head neck heart and lungs was negative. Examination of the abdomen revealed a mass in the right upper quadrant. The surface was smooth and the lower pole was at the left of the umbilicus. The lower pole was rounded and the mass had distinct respiratory mobility

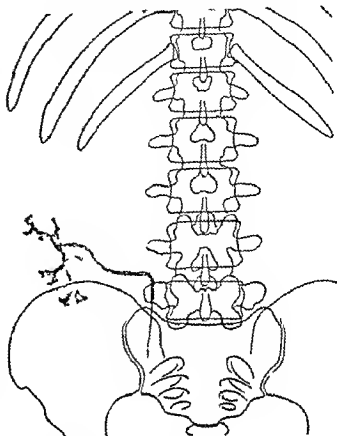


Fig 5 Case 4 Cyst of the pancreas Note displacement of renal pelvis and upper ureter

and seemed to disappear beneath the costal arch. Examinations of the pelvis and central nervous system were negative.

The blood pressure was systolic 124 diastolic 70. The Wassermann test was negative and a blood examination showed a slight anemia. The cystoscopic examination was negative.

Roentgenographic examination showed that the left pyelogram was normal. The right pyelogram revealed that the pelvis was normal in size but that it formed an obtuse angle with the ureter and there was displacement of the upper portion of the right ureter (Fig 5).

From the urological findings the presence of a hydronephrosis was excluded and a pre-operative diagnosis of pancreatic cyst was made. An operation was performed and the diagnosis was verified. The patient made an uneventful recovery and was discharged on December 5 1935.

LESIONS OF THE COLON

Lesions of the large bowel are of interest to the urologist because some of them may result in the production of enterovesical fistulae. The two lesions most frequently responsible for the production of the fistulas are diverticulitis and carcinoma. Simple, or so called self limiting, diverticulitis may produce bladder symptoms occasionally and hence be the subject for differential diagnosis. When the inflammatory process extends beyond the wall of the diverticulum, peridiverticulitis with abscess formation occurs. The



FIG. 1. Case showing the presence of stones in the bladder—a case of vesico-enteric fistula.

abscess may rupture into the bladder either with or without the formation of an enterovesical fistula. In one of our cases after the abscess had ruptured into the bladder the patient developed abscesses in the abdominal wall which required surgical intervention.

As an example of an enterovesical fistula due to the diverticulitis and peridiverticulitis I should like to present the following case in which the patient also had stones in the urinary bladder.

CASE 1. (a) Enterovesical fistula (b) chronic diverticulitis (c) peridiverticulitis (d) vesical calculi (e) cystitis. W. H. male aged 50 was admitted to the Presbyterian Hospital on June 1, 1930.

For the past 6 years the patient has had more or less indefinite pain in the abdomen. The pain was not constant. At this time he began to have some trouble with his bowels so that he had been more or less constipated. Sixteen months ago he noticed pain and burning on urination. There was some frequency of urination as well. Shortly after the onset of bladder symptoms the patient noticed the presence of small flakes in his urine. He then went to a doctor who told him he had fecal material in the urine. The patient also noticed passage of gas with the urine.

Examination of the eyes ears nose throat chest and heart was negative. The rectal examination showed a 1 plus enlargement of the prostate and slight tenderness of the right lobe. Seminal vesicles were not palpable. Examination of the blood showed 4,250,000 red blood cells, 9,600 white blood cells and a hemoglobin of 31 per cent. Examination of the urine on admission to the hospital showed no sugar albumen or blood. Sediment showed 240 leucocytes per cubic millimeter. Cultures revealed hemolytic *Bacillus coli communior* and small colonies of diplococci.

Cystoscopic examination showed the presence of an opening on the left lateral wall surrounded by some edema. There was slight intravesical enlargement of the prostate and on the floor of the bladder 2 large stones were seen.

Röntgenographic examination showed the presence of arthritis in the lumbar spine and 2 stones in the bladder (Fig. 6). Intravenous pyelograms were negative. Chest fluoroscopy was negative and the barium injection into the colon met an obstruction low in the sigmoid. No study was made out.

A litholapaxy was done on March 22, 1932 and a cystoscopic examination at the end of the operation showed the bladder to be free of stones and fragments of stone. Dr. Edwin Miller was asked to see the patient in consultation and he concurred in the diagnosis of diverticulitis with perforation into the bladder. A colostomy was performed by Dr. Miller on July 3, 1936.

Chemical examination of the stones revealed a mixture of calcium oxalate carbonate and triple phosphate with a trace of urates. The patient was discharged from the hospital on July 20, 1937.

Cancer of the rectum may occasionally perforate into the bladder with a resulting rectovesical fistula. On the other hand carcinoma of the prostate or bladder may involve the rectum with perforation with a resulting fistula between the bladder and the rectum. These situations however are rather uncommon and offer no difficulty in the way of diagnosis.

ACUTE PYELITIS FOLLOWING OPERATION

During the postoperative course following a major surgical operation symptoms and signs may develop that are difficult to interpret and evaluate. (1) The clinical picture may be due to a lesion not recognized before operation and yet part of the primary pathology for which the patient was operated upon. (2) The clinical picture may be due to a lesion of the urinary tract which because of the absence of symptoms and signs was not recognized before operation for instance the presence of a stone in the kidney or ureter. But following operation an acute pyelitis develops and the true condition in the urinary tract is then recognized. (3) A combination of symptoms that may be due in part to both conditions.

Under certain circumstances it may be very difficult to decide which of the two lesions is the dominant one. This question may assume quite an important role in case one or the other lesion demands surgical intervention. Naturally great care must be exercised in arriving at the proper conclusion as to whether the patient should be operated upon and if so which of the two lesions should be cared for first. An interesting problem bearing on this subject is presented in the following case.

CASE 6. (a) Carcinoma of the rectum (b) metastasis to the liver (c) stone in left kidney (d) left hydronephrosis.

(e) pyelitis Mrs S. aged 65 was admitted to the Presbyterian Hospital on the service of Dr V C David on May 24 1938. The previous history was negative. The patient had always enjoyed good health until without apparent reason she suddenly began to feel weak. The weakness gradually increased. Several weeks later she began to have pain in the rectum and this was followed by a change in bowel habit. The patient suddenly developed a marked persistent diarrhea.

The physical examination was negative except for the presence of carcinoma of the rectum.

Examination of the blood showed 4 200 000 red blood cells 10 500 white blood cells and a hemoglobin of 50 per cent. The urinalysis on admission was negative.

A left inguinal colostomy was done by Dr V C David on May 28 1938 and a perineal resection on June 11 1938.

Roentgenographic examination. The right pyelogram was normal. The left pyelogram showed dilatation and clubbing of the calyces and the presence of stones in the pelvis of the left kidney. Presence of calcified glands near the spine and calcifications in the spleen (Fig 7).

Following the perineal resection the patient developed some fever. On the thirteenth day after operation examination of the urine showed the presence of a good deal of pus. On the twenty fifth day the patient developed tenderness over the left kidney. The temperature continued to fluctuate between 100 to 103 degrees. Examination of the urine revealed a great deal of pus and there were 100 cubic centimeters of residual urine. Examination of the abdomen showed tenderness of the left kidney posteriorly and the presence of a large palpable mass in the right upper quadrant. The mass was tender and the nature of it was indefinite. The diagnosis rested between enlargement of the liver and right sided hydronephrosis.

The patient was treated with Mandelic acid and indwelling catheter drainage was instituted but this had no effect on the temperature until an indwelling ureteral catheter was placed in the left ureter. This brought the temperature down immediately but 3 days later there was a sudden rise. Catheters were inserted in both ureters and left in place. This brought the temperature down and 5 days later the catheters were removed. The patient was discharged on July 27 1938.

LESIONS OF THE GYNECOLOGICAL TRACT

Various pathological conditions in the gynecological tract are often the cause of urinary symptoms. On the other hand in some cases the patient may have disease in the urinary tract that is the direct cause of urinary symptoms, and with it may be associated conditions in the gynecological tract, such as prolapse of the uterus, cystocele, rectocele, fibroid, and various lesions of the tubes and ovaries. It is not at all an infrequent occurrence to see a patient in whom the urinary symptoms are erroneously attributed to the pelvic disease and for which the patient is operated upon without relief of the urinary symptoms. Among some of the more frequently overlooked lesions may be mentioned chronic pyelonephritis, hydronephrosis renal and ureteral stone, renal tuberculosis and elusive ulcer of the bladder. Just as the gynecologist should bear in mind the fact that his patient may also have a lesion in the urinary

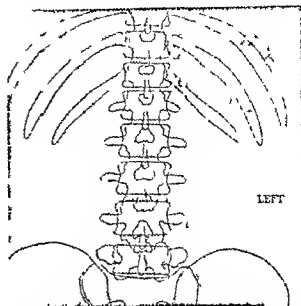


Fig 7. Case 6. The right pyelogram was normal. The left pyelogram showed dilatation and clubbing of the calyces and the presence of stone in the pelvis of the left kidney. Calcified glands near the spine and calcifications in the spleen. Note enlarged right kidney.

tract so must the urologist bear in mind that his patient's symptoms may be due to a lesion in the gynecological tract. The necessity for a complete urological survey in this group is perfectly obvious. As an illustration of a patient belonging to this group I wish to present the following case.

CASE 7. (a) Carcinoma of the right ovary. (b) fibromyoma of the uterus. Mrs I T. aged 30 was admitted to the Presbyterian Hospital on October 6 1931. The previous history was negative. The patient consulted me because of pain in the back and frequency that she attributed to disease in the urinary tract. The present illness began 8 months before her admission to the hospital at which time she noticed pain in the right lumbar region. The pain gradually increased in severity and radiated toward the front. At times she also had pain in the right side of the abdomen low down. The pain was associated with an intense desire to void and kept her awake at night. It was relieved by urination. The patient was obliged to void 7 to 3 times at night and there was some increased frequency of urination during the day. Two months before admission she noticed a fullness in the epigastrium after eating. The bowels were constipated. There was no vaginal bleeding or discharge and no hematuria. Menopause had begun 6 months before.

Physical examination was made by Dr E E Irons. Examination of the head, neck, heart and lungs was negative. There was some tenderness on deep pressure over the right kidney. Vaginal examination showed a mass the size of a small orange to the right of the uterus which was about twice its normal size. Examination of the urine was negative except for the presence of a few white blood cells. The blood count showed 4 010 000 red blood cells 26 600 white blood cells and a hemoglobin of 62 per cent. The blood pressure was systolic 132 and diastolic 82.

Roentgenographic examination was negative for stone. Intravenous urograms were negative. Chest fluoroscopy, gastro-intestinal studies and gall bladder were negative.

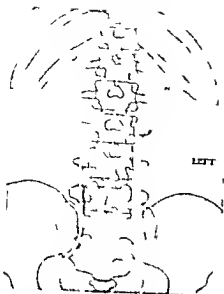


Fig. 8. Case 8. Hydronephrosis and hydro ureter due to carcinoma of the ovary.

On October 1, 1931, Dr. N. S. Heaney performed a bilateral salpingo-oophorectomy and a supravaginal hysterectomy.

Pathologic diagnosis: Krukenberg tumor of the right ovary and fibroids of the uterus.

In this case, although there were no especial problems in the diagnosis, the symptoms which brought the patient to me were essentially urological and there were no symptoms referable to the gynecological tract. The urological symptoms, namely, pain in the right lumbar region that radiated forward, pain in the right lower quadrant, and frequency of urination, gave the clinical picture a decidedly urological aspect. However, with the negative findings from the urological point of view, plus the results of the pelvic examination, the diagnosis was relatively simple.

Pain in the left upper quadrant occurs much less frequently than it does on the right side, and as a rule it offers fewer problems in differential diagnosis than do lesions on the right side. In other words, with fewer organs on the left side than on the right, there is less pathology and consequently fewer diagnostic problems. However, lesions do occur that present a clinical picture that is not always perfectly clear, and it is necessary to differentiate lesions of the colon, kidney, and spleen. I should like to present the following case as an illustration.

CASE 8. (a) Left hydronephrosis, (b) left hydro ureter, (c) papillary carcinoma of the ovary. Mrs. M. D., aged 36, was admitted to the Presbyterian Hospital on October 11, 1938, on the service of Dr. J. B. Eyerly. Her complaints

on admission were abdominal distress, menorrhagia, frequency of urination, and loss of weight. The patient stated that she was operated on for a dermoid cyst of the left ovary in June, 1937, at which time the left fallopian tube and appendix were removed, and that following this operation she experienced an indefinite dragging and pulling sensation at the lower end of the operative scar. The patient complained of an abdominal distress which she described as a bloated feeling in the abdomen. Constipation began 2 months after her operation with hard bowel movements. She also complained of a dull aching sensation in the left side of the abdomen. This pain had been present more or less constantly and increased gradually in severity, disappearing before the onset of menstruation and reappearing following menstruation. In the beginning of October, 1938, the patient began to have frequency of urination both day and night.

Physical examination was made by Dr. J. B. Eyerly. Examination of the heart, lungs, head, and neck was negative. A vaginal examination by Dr. N. S. Heaney showed a swelling the size of a hen's egg on the left side, in the region of the uterine artery, extending from the side wall of the uterus to the pelvis and involving the sacro-iliac ligament. The blood pressure was systolic 154 and diastolic 100.

The urinalysis on admission showed the urine to be normal. The blood count showed 4,200,000 red blood cells and 11,500 white blood cells. The blood chemistry showed urea nitrogen 18, uric acid 3.8, creatinin 1.4, and non-protein nitrogen 27.1. A hemolymphophthalm test showed an output of 80 per cent in 3 hours.

The cystoscopic examination on October 14, 1938, showed a normal bladder. The right ureter was catheterized without difficulty or obstruction. There was some obstruction to the passage of the catheter up the left ureter. The urines from the right and left kidneys as well as the bladder were free of pus and sterile on culture.

Koentgenographic films were negative for stone. The right pyelogram was normal. The left pyelogram showed dilatation of the kidney pelvis, calyces, and ureter. The dilatation of the ureter stopped at a point below the left sacro-iliac joint (Fig. 8).

Because of the presence of an obstruction in the left ureter with secondary hydronephrosis and pain in the left side of the abdomen, preliminary dilatation of the ureter was carried out prior to the operation. After several dilatations, the patient developed an acute pyelitis for which indwelling ureteral catheter drainage was carried out. A colpotomy was performed by Dr. N. S. Heaney on October 24, 1938. Examination of the pieces removed showed papillary carcinoma. Subsequently, the patient was given radium implantation of 2,000 milligram hours and was discharged on December 1, 1938.

LESIONS OF THE SPINE

Because of the fact that pain in the back is not always of renal origin, it is necessary that the urologist, in his consideration of differential diagnosis, bear in mind the fact that the patient may have a lesion of the spinal column. It is not necessary in this symposium to consider all the lesions of the spine that may be confused with lesions of the kidney, but I wish to call attention to 3 of them: (1) arthritis, (2) lesions of the vertebrae, and (3) prolapse of nuclear pulp.

1. *Arthritis.* Although a relatively common cause of pain in the back that brings the patient

to the urologist arthritis as a rule presents no serious problem in differential diagnosis.

Lesions of the vertebrae. Osteomyelitis of the spine is a relatively uncommon lesion, and it has been overlooked in several cases under recent observation. In some instances the only manifestation of osteomyelitis is pain in the back. In other instances it may manifest itself in the form of a perirenal abscess. Therefore, it is well always to bear in mind the possibility that a perirenal abscess may be due to an osteomyelitis of the spine.

As a rule the diagnosis of a perirenal abscess is relatively easy, especially in the later stages and is based on the presence of pain in the back, fever, leucocytosis, muscular rigidity and a palpable swelling. On the other hand, pain in the back, leucocytosis, fever and muscular rigidity may also be due to osteomyelitis of the vertebrae.

Because of the fact that osteomyelitis of the spine may be the cause of perinephritic abscess it is well to bear this possibility in mind and to consider it as a factor in every case of perirenal abscess. As an example of a case in which osteomyelitis of the spine was overlooked for a long time in a patient who was operated upon for a perinephritic abscess before he came to me, I should like to present the following:

CASE 9. (a) Subacute osteomyelitis of the lumbar spine (b) osteoarthritis of the spine (c) right lumbar incisional hernia (d) secondary anemia (e) bilateral pyelonephritis. H. L. male aged 57 was admitted to the Presbyterian Hospital on December 12, 1934. The patient was in good health until 4 months before his admission to the hospital at which time he complained of pain in the right upper quadrant that radiated to the back. He was admitted to a hospital where a diagnosis of bilateral bronchopneumonia was made. A few days later he developed pus in the urine and he began to run a septic type of temperature. The pyuria increased and he developed tenderness in the right renal area. A diagnosis of right perinephritic abscess was made and he was operated upon. He was discharged from this hospital 3 weeks after operation.

Shortly thereafter he developed pain in the left side localized on a level with the third lumbar vertebra and he again began to run a septic temperature. He was re-admitted to a second hospital where he remained for a short time and then was sent to a convalescent home. The pain in his left lumbar area continued however as did the fever and pus in the urine and he was sent to the Presbyterian Hospital.

The physical examination revealed a poorly nourished male who was in severe pain. Examination of the heart and the lungs was essentially negative. The abdomen showed a recently healed scar in the right renal area and a hernia in the lower end. There was a localized point of tenderness to the left of the spinal column and at the level of the last rib. The rectal examination was negative.

The urine on admission showed some albumen and 2,400 leucocytes per cubic millimeter. The blood count showed 3,800,000 red blood cells and 12,400 white blood cells. The blood chemistry tests were negative.



Fig. 9. Case 9. Note changes at the third lumbar due to osteomyelitis of the spine.

The cystoscopic examination was negative. The ureters were catheterized without difficulty or obstruction. The urine from the right kidney was free of pus and sterile upon culture. The urine from the left kidney showed 5,600 leucocytes per cubic millimeter and cultures showed hemolytic and non-hemolytic *Staphylococcus aureus*. Middle urine showed 640 leucocytes per cubic millimeter and hemolytic and non-hemolytic *Staphylococcus aureus*. Smears of the urine were negative for tubercle bacilli.

Roentgenographic examination. The films were negative for stone. The right pyelogram was negative and the left showed a slight dilatation of the pelvis and slight clubbing of the calyces. The roentgenogram showed a destructive lesion involving the body of the third lumbar vertebra (Fig. 9).

A diagnosis of osteomyelitis of the body of the third lumbar vertebra was made. Dr. Kellogg Spced was asked to see this patient in consultation and he concurred in the diagnosis. From the evidence obtained a diagnosis of subacute osteomyelitis of the body of the third lumbar vertebra was made and appropriate orthopedic treatment instituted. The patient made a complete recovery and was discharged on December 26, 1934.

3 Prolapse of nuclear pulp. During the past few years many articles dealing with prolapse of the nuclear pulp or Schmorl's disease, have appeared in the literature so that it is not necessary to enter into a detailed discussion or description of this relatively recently described condition. Of prime importance, as far as the urologist is concerned, is the fact that he should constantly bear in mind the possibility that it may be the cause of pain in the back and he should not fail to have a lateral roentgenogram made of the spine. This is now a routine procedure even when obvious pathology in the urinary tract is present, since it is possible in some of these cases that both lesions may be present at the same time. I should like to present the following case as an example.



Fig. 10 Case 10 Calcified nuclear pulp at intervertebral discs

CASE 10 (a) Congenital solitary kidney right (b) hydronephrosis right (c) hydro-ureter right (d) bilateral kidney pelvis right (e) prolapse of nuclear pulp. Mrs. S. aged 44 was admitted to the Presbyterian Hospital on January 22, 1936. The past history was negative. Her complaints began about 6 weeks before consultation at which time she had frequency of urination and some burning in the urethra. The patient also noticed that her urine was dark and cloudy and on examination it showed a small amount of blood and considerable pus. The blood cleared up in 7 or 8 days and has not again appeared. The patient also complained of pain in the back. She had been treated with pelvic lavage elsewhere.

Examination of the heart, lungs, head and neck was negative. The liver and right kidney were palpable and there was no lumbar tenderness. A pelvic examination revealed an infantile uterus. The blood pressure was systolic 124 and diastolic 82.

The blood count and blood chemistry were negative. Examination of the urine on admission was negative. Phenolsulfonphthalein showed an output of 80 per cent in 1½ hours.

The cystoscopic examination showed a normal bladder. The right ureteral orifice was normal in size, shape and position. No left ureteral orifice was found after very careful search. Examination of the bladder urine showed no pus. Cultures showed *Bacillus coli*. Guinea pig inoculations were negative for tuberculosis.

Röntgenographic examination. The plain film was negative for stone. The right kidney outline was very large extending from the fifth lumbar to the twelfth dorsal. The kidney outline on the left side was not visualized. Intravenous pyelograms showed a very large right kidney pelvis with a possible slight dilatation of the right ureter. There was no visualization on the left side. A lateral film showed a rather unusual type of calcification at the intervertebral discs. Instead of one large island of calcification centering two-thirds of the way back in the disc one sees many smaller islands at the junction of the second, third, fourth and fifth which center two-thirds of the way forward in the disc. In addition the margins of vertebrae are cup shaped as in nuclear pulp enlargement (Fig. 10). The patient was discharged from the hospital on January 25, 1936.

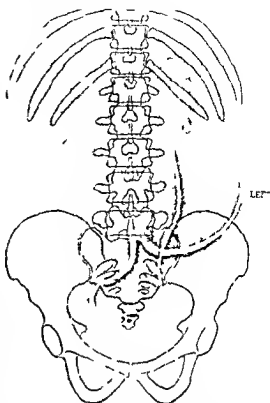


Fig. 11 Case 11 Note displacement of the catheter in the right ureter and small hydronephrosis of the left kidney. The shadow produced by the hydronephrosis is nearly fills the abdomen.

Following the acute onset of urinary symptoms a diagnosis of acute pyelitis was made. Appropriate treatment was carried out and the condition cured. However the pain in the back continued and it was for the persistence of pain that the patient consulted me.

Pain in the back is often associated with acute renal infection and it disappears when the infection is cured. Therefore its persistence should always arouse our suspicions that the patient must have some other type of pathology that explains the cause of the symptoms which in this case was demonstrated with a lateral roentgenogram.

HYDRONEPHROSIS

Hydronephrosis is one of the common lesions of the kidney that is frequently overlooked and confused with various intra abdominal lesions. In some cases there are no symptoms referable to the kidney and the hydronephrosis is discovered only upon routine examination. In other instances the only manifestation of hydronephrosis is indefinite pain in the abdomen the cause of

which is not recognized, and, in some cases an abdominal operation is performed without relief of symptoms

Because of the large size of the hydronephrosis, the condition may be confused with various types of intra abdominal swellings. In another group of cases the patient may develop severe pain, which may even result in shock and collapse, so that the clinical picture is that of an acute intra abdominal emergency. As an example, I should like to present the following case

CASE 11. Bilateral hydronephrosis. W S. male aged 24 was admitted to the Presbyterian Hospital on July 29 1937 on the service of Dr. William Kirby

The patient complained of a mass in the abdomen which he said had been present for 2 years. Three years before his admission to the hospital the patient had a severe fall at which time he had severe abdominal pain. The next day he noticed that his urine was very bloody. The hematuria continued for 10 days. Two years before his admission to the hospital he was in an automobile accident was unconscious and again passed bloody urine for 10 days. Since the second accident the patient noticed the presence of a mass in the abdomen which gradually increased in size. The swelling had become more noticeable during the past 6 months

Examination of the heart lungs head and neck was normal. The abdomen appeared distended and the right half was much more prominent than the left. The right costal arch was elevated and the maximum fullness appeared to come out from under the arched ribs. A superficial vein was visible on the right side of the abdomen running from the costal arch down to the level of the umbilicus. The entire abdomen was very tense except for a small area in the lower left quadrant. There was no pain or tenderness and one gained the impression that the mass was cystic and not solid. The blood pressure was systolic 174 and diastolic 110.

Examination of the urine showed no sugar or albumen an occasional red blood cell was seen and there were 140 white blood cells per cubic millimeter. There were a few granular casts in the urine. The blood count revealed 6 270 000 red blood cells 12 000 white blood cells and a hemoglobin of 98 per cent. A Wassermann test was negative. Blood chemistry showed urea nitrogen 14.0 ure acid 4.3 non protein nitrogen 36.5

The cystoscopic examination was normal. The ureters were catheterized without difficulty or obstruction. The urines from the right and left kidneys as well as the bladder were free of pus cells. The urine from the right kidney contained a few red cells and cultures were sterile all around.

A roentgenographic examination on August 3 1937 showed no evidence of stone in the urinary tract. The kidney outlines were obscured by a large soft parts shadow that nearly filled the entire abdomen. The right ureter catheter passed upward toward the top of the sacrum and from this point it curved to the left so that it lay at the left border of the previously described shadow. The left ureteral catheter followed a normal course (Fig. 11). The left pyelogram showed the presence of a small hydronephrosis. No outline of the right pelvis could be demonstrated in the x ray film.

Seven days after admission to the Presbyterian Hospital the patient developed a sudden severe attack of pain. There was a rapid increase in the size of the abdomen. The pulse rose from 76 to 126 and the temperature to 101 de

grees. The patient had severe nausea and vomiting and the pain increased in severity and was only slightly relieved by a hypodermic injection of morphine. He rapidly went into shock and collapse and it was necessary to give him a blood transfusion. In addition he was given intravenous injections of glucose and external applications of heat. The patient gradually improved and a right nephrectomy was done on August 6 1937. Because of the enormous size of the hydronephrosis it was necessary to aspirate it. The fluid removed measured 6 100 cubic centimeters and was dark in color due to the presence of old blood. The patient made an uneventful recovery and was discharged on September 1 1937.

This patient presented a rather interesting problem in differential diagnosis because of the sudden onset of the severe pain which was followed by shock and collapse and because of the increased rigidity of the abdominal wall. This sudden change in the clinical picture immediately raised the question of the possibility of our dealing with a double lesion, and that the patient besides his hydronephrosis might have any one of the following lesions: acute pancreatitis, mesenteric thrombosis, acute intestinal obstruction, or perforation of a hollow viscus, such as rupture of a gastric or duodenal ulcer or an acute gangrenous gall bladder.

RETROPERITONEAL TUMORS

It is a well known fact that retroperitoneal tumors produce no typical clinical symptoms by means of which they can be recognized, and, that as a rule, when the patient is seen, the tumor has reached a large size. In an occasional case the tumor is discovered after the patient has received an injury, and in other instances the only complaint is that of indefinite pain.

Retroperitoneal tumors are often confused with lesions of the kidney, adrenal, pancreas, and Riedel's lobe of the liver. A complete urological study is always indicated and is most informative. Ureteral catheterization and retrograde pyelograms show two common findings that are of great value, namely, displacement of the kidney pelvis with or without changes in the pyelogram, and changes in the course of the ureter. As an illustration of a patient in whom both of these findings were present, I should like to present the following case.

CASE 12. (a) Retroperitoneal fibrosarcoma. Mrs. A. S. aged 64 was admitted to the Presbyterian Hospital on the service of Dr. William A. Thomas. The previous history was negative. The patient on admission to the hospital complained of right sided low backache which was gradual in onset. It was described as a dull ache never severe nor colicky in nature which was relieved by lying down and by heat and aspirin. There were no urinary symptoms.

The heart lungs head and neck were negative. Examination of the abdomen revealed a hard smooth mass in the right mid abdomen about the size of an orange and

Diaphragm

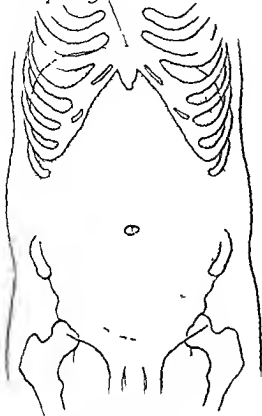


Fig. 12. f. enormous dilatation of the urinary bladder due to obstruction at the bladder neck.

there was some respiratory mobility. There was no tenderness. The vaginal examination was negative. Examination of the blood, urine, and stomach content was proved to be normal.

Cystoscopic examination showed a normal bladder. The ureters were catheterized without difficulty or obstruction. The urines from the right and left kidneys as well as the bladder were free of pus and sterile on culture. Smears revealed no tubercle bacilli.

Röntgenographic examination. The examination was negative for stone in the urinary tract. The right pyelogram showed a normal pelvis except that the pyelogram was tilted outward and to the right. The right ureter curved outward and to the right and there was slight dilatation of the right ureter over the sacrum. The left pyelogram was normal. A large, irregularly rounded or nodular soft tissue density was seen filling the right side of the abdomen. This shadow extended from the lower edge of the eleventh rib to the mid part of the sacro-iliac joint and from the right margin of the spine laterally to the edge of the film.

An operation was performed on October 24, 1935 by Dr. F. M. Müller and Dr. H. L. Kretschmer. Laparotomy showed a retroperitoneal tumor mass and the sections removed showed the presence of a fibrosarcoma. The patient made an uneventful recovery and was discharged from the hospital on November 24, 1935.

From the careful pre-operative study it was perfectly obvious that we were dealing with a retroperitoneal tumor probably malignant and that the tumor mass was extra-urinary. The presence of a normal pyelogram which was tilted, the tilting of the kidney, the dislocation of the right ureter with a normal pyelogram left little room for doubt that the tumor was retroperitoneal and not connected with the kidney.

ELUSIVE ULCER

One of the lesions of the urinary tract frequently confused with lesions of the lower abdomen is the so-called elusive ulcer. This condition is relatively uncommon yet it occurs with enough frequency to justify bearing it in mind in the differential diagnosis of lesions of the lower abdomen. Unfortunately, this lesion is not taken into consideration frequently enough with the net result that many of these patients are not seen until after they have had a prolonged course of local treatment or until after they have had one or more abdominal operations without avail. In many of these cases the symptoms are attributed to a diseased appendix and an appendectomy is done. In another group various gynecological procedures are carried out without relieving the symptoms in any way.

It is in this group of cases that the value of a history is apparent. When a patient states that she has frequency of urination, urgency and severe bladder pain, and if the symptoms have not been relieved by various forms of local treatment or by one or more surgical operations, we make a working diagnosis of elusive ulcer. These cases are overlooked because we fail to bear this possibility in mind during the differential diagnosis. It is to be remembered that in probably the majority of them the urine is clear and sparkling and the urinary examination may be negative. The diagnosis rests upon the cystoscopic examination, the findings being quite characteristic.

DIFFERENTIATION BETWEEN ASCITES AND CHRONIC URINARY RETENTION

As a rule lesions of the bladder, such as stones, tumors, ulcer, and vesical neck obstruction, are not very frequently confused with intra-abdominal lesions and it is relatively rare that they are considered in the problems of differential diagnosis between abdominal and urinary disease. A chronically distended bladder may reach such an enormous size that the full bladder may be confused with ascites. At times difficulty may arise in making a differentiation between ascites and an overdistended bladder.

The presence of a suprapubic tumor due to chronic urinary retention as a rule does not present any special problems in differential diagnosis. A long standing history of urinary obstruction, the rather characteristic outline or shape of the swelling, and the results of catheterization suffice to establish the diagnosis.

When the distention of the urinary bladder reaches to or above the xiphoid cartilage (Fig. 12), this condition may be and has been confused with ascites. In cases of this kind there is extensive displacement of the intestines just as occurs in ascites which adds to the diagnostic problem.

Urinary symptoms when present may be ascribed to the ascites, it being assumed that the ascites mechanically interferes with the act of

micturition. The differentiation between ascites and chronic urinary retention of this magnitude rests upon the results of catheterization. It is needless to emphasize that the removal of the urine must be done very slowly and under close observation.

SUMMARY

The role of the urologist is a very important one in the differential diagnosis of abdominal disease. He must be familiar with the various types of intraperitoneal, as well as retroperitoneal lesions that may be confused with lesions of the genitourinary tract. It is most important that he be familiar with complications that arise following general and gynecological surgical procedures.

A CLINICAL STUDY OF ALLOY STEEL WIRE SUTURES IN HERNIA REPAIR

LOUIS RENÉ KAUFMAN, M.D., F.A.C.S. WILLIAM W. JOHNSON, M.D. and
ALBERT LESSER, M.D., New York, New York

THEKEL is general agreement among surgeons that for satisfactory wound healing the rôle of the materials employed for ligatures and sutures is of particular importance. Such materials should be sterile and pliable, fine and delicate in texture, with such tensile strength as to maintain approximation of tissues without prolonged or excessive irritation. The relative value of absorbable and non absorbable sutures has long been a subject of discussion, and the discussion has largely been concerned with silk and catgut. Catgut continues to be generally favored by surgeons by reason of the emphasis placed upon absorbability as the decisive element in satisfactory wound closure, and therefore it still remains our standard material. However, its absorbability frequently gives rise to serious complications in wound healing, since in some cases it may fail to persist long enough to accomplish its purpose of coaptation until union may occur. In other cases its absorption is so long delayed that its reaction is that of a non absorbable suture.

Kraissl, in a thorough review of the subject, has stressed the many inadequacies of the absorbable suture materials, particularly with reference to the problem of wound disruption. Kraissl, Babcock, and others have demonstrated catgut allergy and its deleterious effects on wound healing. Clock has shown the dangers of unsterile catgut in studies of standard brands of catgut; furthermore, he has demonstrated the disadvantages of processing by chemical sterilization.

Recently interest has been stimulated in the use of non absorbable suture materials, and particularly wire. Silver wire was successfully used by Shipley in the secondary repair of operative wound disruptions. Reid Zininger and Merrill reported an extensive use of silver wire in the closure of the abdomen in cases of acute abdominal emergencies, particularly in the presence of great tension, marked tissue friability, probability of infection, or marked general debility. Their technique consisted in the use of interrupted

through and through sutures of all abdominal layers, these sutures being removed in 15 to 20 days. In a large series of cases studied over a 10 year period, there were no wound disruptions and a markedly decreased incidence of post operative hernia.

Stainless alloy steel wire, as described by Babcock, has numerous advantages over silver wire, and is gaining popularity as experience in its use enlarges the zone of its application. It does not tarnish or corrode, and consequently does not produce tissue discoloration; has greater tensile strength and is less brittle than silver wire, is absolutely impermeable and easily manipulated. Its use in fine sizes permits accurate layer for layer closure in the form of buried sutures and easy applicability in the ligation of vessels. It is easily sterilized and relatively inexpensive.

Dambrin has used alloy steel wire sutures in abdominal closures over a long period of years, using a two-layer technique: a deep buried layer of figure of eight sutures for fascia, muscle, muscle sheath and peritoneum, and a superficial layer of removable steel wires. He was impressed with several observations: (1) the absence of post operative discomfort at the site of buried sutures; (2) the fact that even when wounds became grossly infected, exposing the deep layer of wire sutures, the sutures remained intact with firm healing after control of the infection; (3) the complete absence of wound disruption; (4) the fact that these patients could be exposed to diathermy or x-ray without any untoward results. De Mendonca reports the use of alloy steel wire in an extensive series of cases. He has used wire exclusively in vesicovaginal fistulas, uranoplasties, perineorrhaphies, hernias, and abdominal wall repairs. He too was impressed with the fact that even in the presence of severe infection and prolonged drainage, wire sutures remained intact and maintained firm coaptation of tissues. H. Welt emphasized the following advantages of alloy steel wire buried sutures: (1) they are inextensible and therefore cause minimal tissue reaction; (2) the unusual tensile strength of alloy steel wire permits its use in very fine sizes, therefore reducing the bulk of buried suture material.

From the Department of Surgery, New York Medical College, the Flower and Fifth Avenue Hospital, and Metropolitan Hospital.

In an attempt to clarify the status of alloy steel wire sutures we conducted two investigations which form the basis of this paper (1) a study of 56 consecutive cases of hernia repairs, (2) a study of wound repair in dogs

A THE STUDY OF HERNIA REPAIRS

In this series of 56 consecutive hernia operations at the Metropolitan Hospital and the Flower and Fifth Avenue Hospital, suture materials were used in the following groupings: Group 1—25 cases—catgut chromicized and plain, was used throughout for buried sutures. Group 2—18 cases—alloy steel wire sutures used for repair of the anatomical structural defects, with catgut for the peritoneal sac and hemostatic ligatures. Group 3—10 cases—alloy steel wire sutures were used exclusively throughout, including repair of the defect, peritoneal sac, and hemostatic ligatures. Group 4—3 cases—black silk was used throughout, including peritoneum and ligatures.

The plain catgut, chromicized catgut, and black silk were of the usual standards and sizes and were employed in standard technique. The stainless alloy steel wire was used in two sizes: the No. 35 B&S gauge (0.0007 inch), with a tensile strength of $2\frac{1}{2}$ pounds, was employed for ligature ties and delicate approximating the No. 30 B&S gauge, with a tensile strength of 15 pounds was used for supporting structures (closing hernia defects). The wire was handled as were other suture materials: care was taken not to kink the wire and ends were cut close to the knot and flattened wherever possible. The wire was usually employed as an interrupted suture but in several instances we have employed the fine wire as a continuous suture. For supporting structures (such as approximating conjoined tendon to Poupart's ligament), double strands of No. 35 wire were used in many of the cases.

All clinical case groups were closely observed during the immediate postoperative course. The operative wounds were classified as follows: (1) clean, absence of infection, (2) infected, gross evidence of pus requiring drainage, (3) presence of seroma, that is, our clinical designation of a gross accumulation of serum or blood requiring evacuation, without subsequent suppuration. At the time of discharge from the hospital, each wound was carefully examined with the purpose of determining the relative amounts of wound induration in the various suture type cases. Again approximately 1 year after this study was initiated, all cases were brought back for a follow-up examination. The time elapsed between date of operation and date of follow-up examination

varied from 2 to 10 months. At this time each patient was examined with an attempt to determine (a), the relative amount of wound induration, (b) recurrence or weakness, (c) any symptomatic complaints referable to the type of suture material used.

ANALYSIS OF CLINICAL CASE GROUPS

Types of hernia. In this series of 56 cases, 42 were elective inguinal operations: 1 a strangulated inguinal (emergency) operation, 1 a strangulated femoral (emergency) operation, 8 postoperative incisional hernia (ventral) repairs and 4 recurrent inguinal repairs.

Incidence of infection. In group 1, catgut sutures, in 25 operations, there were 6 infections, an incidence of infection of 24 per cent. In group 2, combined catgut and wire, there were 18 operations, with 2 infections, an incidence of infection of 11 per cent. In group 3, wire exclusively, there were no infections in the 10 operations. In group 4, black silk exclusively, of 3 operations there were 2 infections.

We wish to stress at this point that the incidence of suppuration in these 3 cases in group 4 is rather the exception to our satisfactory experience with the use of black silk in many other types of clean cases. In our experience the use of fine silk in wounds closed without drainage has been attended by a low incidence of suppuration, but the 2 cases in which infections occurred were secondary repairs of very extensive ventral incisional hernias and because of a large amount of dissection and considerable oozing, were closed with drainage with catgut employed for ligatures. Halstead many years ago stressed the necessity for accurate hemostasis and the absence of drainage for exhibition of silk in wound repair.

Incidence of seroma. In group 1, no seromas occurred. In group 2, 5 seromas occurred in 18 operations, an incidence of 27 per cent. In group 3 there were no seromas. In group 4, 1 seroma occurred in 3 operations, an incidence of 33 per cent.

Degree of wound induration. We realize that wound induration is a matter of individual interpretation, but since all cases were observed by the three authors, we feel that the interpretations were relatively fair. At the time of discharge from the hospital following operation the wound induration in groups 2 and 3 (that is, all cases in which wire sutures were used either entirely or in major part) was definitely less than in the catgut or black silk groups. At the time of follow-up examination, however (2 to 10 months later), the various suture type cases could not be distin-

gushed from one another from the standpoint of relative wound induration

Recurrences At the time of follow up examination there was only 1 recurrence and that was in a black silk repair of an incisional hernia with severe wound infection. Because of the short period of time elapsed, however, we feel that no value can be attached to the report of recurrences.

Symptomatic patient complaints There were no complaints of discomfort sticking or pricking sensations referable to the use of steel wire sutures.

B THE STUDY OF WOUND REPAIR IN DOGS

Recently we attempted by means of animal investigation to ascertain whether or not our clinical impressions of alloy steel wire sutures could be confirmed under the microscope. It was therefore necessary to determine the tissue reaction of an individual animal to various types of suture material. The experiment was carried out on dogs as follows. The abdomen of each dog was divided into four quadrants. In each of these quadrants under aseptic technique, an operative incision was made in the anterior abdominal wall extending through the peritoneum. The wounds of the two right quadrants were closed layer by layer throughout with interrupted sutures of No. 35 gauge alloy steel wire, wire also being used for all ligature ties. The incision in the left upper quadrant was closed in the same manner with black silk throughout. The incision in the left lower quadrant was closed with No. 1 chromic catgut. The tissues of the one dog were thus subjected to the foreign body effects of the various suture materials. At varying time intervals of 4, 8, 12, 16 and 20 days the dogs were reoperated upon and the suture line areas excised *en bloc* including skin through peritoneum. The gaping defects left in the abdominal walls by these procedures were then closed with through and through interrupted sutures of alloy steel wire which were subsequently removed.

During the course of the experiment we were again impressed with the observation that the wounds closed with wire healed more rapidly and with less induration, redness and swelling than the wounds which were closed with either black silk or catgut. The clinical observation of the experimental wounds healing gave us the same results as we had observed in the healing of wounds among our patients. In only one instance did gross infection of an incision occur. This happened in a right lower quadrant wound following a secondary closure under marked tension of a large tissue block defect after removal of an

abdominal wall section. We were impressed with the rapid healing which occurred in this wound following control of the infection 8 days after the infection was first discovered and treatment instituted, the wound was completely healed, the infection was cleared up and healing proceeded without the removal of any of the wire sutures. There were no cases of evisceration, no weak scars or hernia and all the dogs survived operation and reoperation.

As the "blocks" of tissue were removed from the animals they were brought to the surgical pathological laboratory where sections including all the layers of the abdominal wall were made. The slides thus prepared were examined in an attempt to determine whether or not there were quantitative or qualitative differences in the tissue reactions of the individual dog to the presence of the various suture materials and also whether microscopy could reveal the extent of healing in the various instances. The findings as reported by Dr. L. C. Reid of the department of surgical pathology were as follows: "Those specimens containing the alloy steel wire showed less necrosis and less inflammatory exudate than the sections containing either the silk or catgut. The degree of proliferative reaction and fibrous tissue replacements in the wire sections parallel closely the findings in the silk sections and these two are further advanced than similar reactions shown in the sections from the catgut wounds."

It is evident that exact differences of tissue reaction in the dog to various suture materials could not be demonstrated microscopically. Furthermore the various day interval specimens of tissue offered no additional microscopic information of significance in this immediate problem of suture material reaction in the dog.

SUMMARY

1. The use of buried steel wire sutures in a series of hernia repairs has resulted in a marked reduction of wound infections.

2. When wire is used in the same wound with absorbable suture materials, there is a marked tendency to seroma formation.

3. Whenever possible therefore, it is advisable that wire suture material should be used exclusively and not with absorbable suture material in the same wound.

4. Despite the presence of infection in cases in which wire was used in combination with catgut sutures, all the wire sutures remained intact throughout the process of wound healing.

5. During the immediate postoperative course there was distinctly less induration, redness and

swelling in the wire cases than in those of other suture materials

6 Two to 10 months later, however, the wire wounds were practically indistinguishable from those in which other suture materials were used

7 Patients have manifested no untoward or uncomfortable symptoms referable to the presence of buried wire sutures in the tissues

8 A study of tissue reactions in dogs to the various suture materials has in general borne out our clinical impressions of alloy steel wire

9 The results of these investigations warrant the further use of alloy steel wire sutures

BIBLIOGRAPHY

- 1 BABCOCK W Ligatures and sutures of alloy steel wire
J Am M Ass 1934 102 1756-1760

- 2 CLOCK R O Fallacies concerning chemically sterilized surgical catgut sutures Surg, Gynec & Obst, 1937 64 1027-1034
- 3 DAMBRIN C Suture of the abdominal wall with buried steel wires Mém Acad de Chir 1937 63 1269-1272
- 4 DEMENDONCA, J Unjustifiable ostracism of metallic sutures Brazil med, 1937 51 441-443
- 5 HALSTEAD, W S The employment of fine silk in preference to catgut Surgical Papers vol 1, p 229
- 6 KRAISSL C J Suture material Review of recent literature Internat Abstr Surg 1936, 62 417-423
- 7 REID, M R, ZINNINGER M M, and MERRILL, I Closure of the abdomen with through and through silver wire sutures in cases of acute abdominal emergencies Ann Surg 1933, 98 890-896
- 8 SHIPLEY, A M A technique for repair of wound disruption Ann Surg, 1925 pp 452-457
- 9 WELTY H New non absorbable suture material in oxidizable steel thread Mém Acad de Chir, 1937 63 712-714

INGUINAL HERNIA

Application of Cardinal Principles in the Repair of Inguinal Hernias

RAOUL L. RAMOS M.D. and CLAUDE C. BURTON, M.D. F.A.C.S., Dayton, Ohio

WE are endeavoring in this article to discuss and present in a clear cut manner a method of repair of hernias in the inguinal regions which in our hands has been quite successful. This method differs in a few essential points from others described in textbooks and recent surgical literature (1, 5, 6, 7, 13, 19). In it we are stressing a few important points in the proper repair of inguinal hernias which have been emphasized at one time or another by different competent workers in the surgical field (1, 5, 6, 7, 10, 13, 16). There is nothing original in this new type of repair of inguinal hernias described later in this article as the principles involved have been thoroughly proved of value in the experimental as well as in the practical field by other observers and workers. However it is our belief that this is the first instance in which a technique for repair of inguinal hernias is presented and described where these principles are well correlated and incorporated in a single simple method of reconstruction of hernial defects in these regions. Recently Zimmerman described a method of his own which is the nearest one in similarity to ours as far as we have been able to determine by reviewing the literature of the last three decades on the subject of Repair of Inguinal Hernias. However there are some points in Zimmerman's method which are disregarded such as the excision of the direct sac or sacs and the final placement of the cord and which we consider of paramount importance in the proper correction of inguinal hernial defects. The few variations shown at the time of the description of the operative technique demonstrate the flexibility and applicability of this method to most of the problems encountered by the surgeon at the time of the operation for hernias in these regions.

Inguinal hernias are divided for anatomical purposes into three main varieties indirect, direct and femoral, depending on the relative position of the component hernial peritoneal sac or locule to the deep epigastric vessels and femoral canal (Fig. 1). It is obvious that according to this type

of classification a femoral hernia is simply a variation of the direct type of defect in which the peritoneal sac or locule insinuates itself in the femoral canal. Unilocular indirect hernias occur frequently in children and very young adults. This fact is easily explained by the anatomical variations and arrangement of internal viscera characteristic of this age group. In our experience chiefly with male patients above the age of 35 years we have rarely encountered this type of hernial defect. Most of the indirect hernial defects in our large series of patients operated upon have consistently presented a definite direct sac or locule which made the type of defects encountered a mixed one, indirect direct type or bilocular type (Fig. 2). This finding has been corroborated with very few exceptions through the routine digital exploration of the peritoneal under surface of the floor of the canal and the subsequent dissection of the direct locule or sac from its attachment to the under surface of the floor of the canal and lateral wall of the urinary bladder. Unilocular direct hernias excepting in recurrences have been similarly rarely encountered as invariably a small demonstrable indirect sac or locule has been found easily and dissected from its attachment to the cord and under brim of the muscular inguinal ring. The direct type of hernia in which the sac or locule projects itself through the relaxed femoral ring is also included in the last group mentioned.

Based on our findings at the time of operation we have been classifying hernias in the inguinal regions according to the number of locules found and radically dissected monolocular hernias which are rare bilocular hernias which are very frequent and the rarer trilocular hernias (indirect-direct femoral or indirect with two separate direct locules). According to this simple classification of inguinal hernias a bilocular hernial defect may be composed of an indirect sac with a true direct simple sac or with a concomitant direct sac projecting into the relaxed femoral canal. Accompanying any of these types of inguinal hernias there may be too associated pseudohermias such as diverticula and fatty masses. The diverticula are frequently found in or near the inguinal triangle (3), and are usually mistaken and classified as direct hernial defects when in reality they are

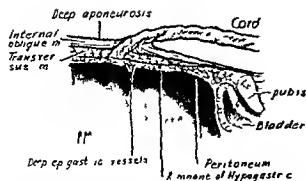


Fig 1 Schematic oblique sagittal section in inguinal region as seen from inner aspect illustrating peritoneal relations encountered in a normal specimen. Note the location of the epigastric vessels remnant of hypogastric artery and peritoneal relations of bladder.

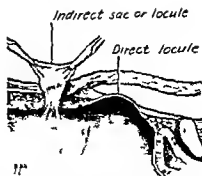


Fig 2 Same type of section through inguinal canal in case of a bilocular hernia (hernia with indirect sac and direct sac). Notice the peritoneal relationship and anatomical position of each sac with reference to the deep epigastric vessels.

a different entity (Fig 3). These diverticula do not possess a peritoneal lining or sac. True hernias, not even excluding sliding hernias, always present some sort of peritoneal sac, otherwise they are considered pseudohernias. Routine bidigital palpation of the anterior and posterior surfaces of the inguinal floor will demonstrate more frequently than reported the presence of this type of anomaly. Pseudohernial fatty masses occur most frequently in the indirect position in the vicinity of the internal ring and before operation they are hard to differentiate from indirect hernial protrusions. The importance of this last type of pseudohernial defect mentioned is great. Their presence does not incapacitate patient in any way and rarely produces symptoms. However, with the strictness of industrial laws and industrial physical examinations an individual with this type of defect can hardly obtain employment as he is consistently refused employment because of the presence of an inguinal bulging. The correction and excision of these two common pseudohernial defects are simple enough and, if present, should be routinely corrected through the usual established methods. In our experience we have had instances of patients operated upon in whom these types of defects were encountered at the time of operation and before operation had been mistaken for simple hernias or recurrences if there was evidence of prior surgical intervention.

The surgical method of repair of inguinal hernias to be described has been steadfastly followed by us in the last 3 years or more and at present a follow up statistical report is in preparation. This method, with few variations, can be applied to all types of hernial defects encountered in the inguinal regions excepting the double and triple recurrent hernias which almost always bring out, as a rule, other problems of structural weaknesses and

have to be met in a different manner by the use of viable fascial sutures or grafts to re enforce the weakened areas or to create a structure which through some congenital maldevelopment has never been present (10, 11, 18). For instance, in very rare occasions the fascia transversalis has been hard to demonstrate or has been absent and then we have been forced to use a pedicle fascia lata graft. This has been done successfully in few cases. The technique described takes longer than the average method of repair of hernias because of the complete and meticulous dissection and excision of the peritoneal locules from their attachment to the understructure of the floor of the canal and lateral bladder wall. On this dissection, we insist, as the radical removal not only of the indirect sac but also of all associated direct sacs or locules is of prime importance, and we believe it bears a definite relation to the success or failure of any inguinal herniorrhaphy. Recurrent hernias are frequently of the direct variety, the indirect sac having been properly excised at the time of the original repair.

Bassant (6) advocated the radical removal of the indirect sac down to its neck and following his

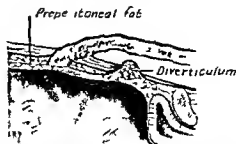


Fig 3 Same type of section through inguinal region in which there is a diverticulum. Notice peritoneal relation to this diverticulum. This is a pseudohernia.

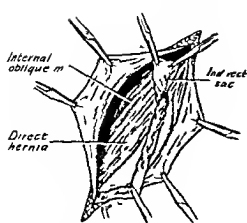


Fig. 4 Appearance of inguinal region after cord has been properly mobilized preventing an indirect hernia and a direct protrusion

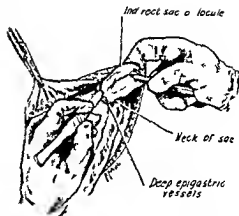


Fig. 5 Indirect sac has been mobilized from the cord and dissection of direct locule is begun. Notice the deep epigastric vessels

method he obtained relatively brilliant results as compared with the Czerny method which disregarded altogether the excision of the peritoneal sacs and which was as a rule followed by more than 80 per cent recurrences. Statistics and our experience reveal that recurrent hernias in the inguinal regions are chiefly of the direct type and we attribute this to failure of removal of the direct sacs at the initial operation although the indirect sac had been properly excised (8). Similarly we have found that our method obviates the more frequent use of other radical methods such as fascial strips or massive fascial grafts (9 to 11, 18). In very few instances severe structural weakness of such magnitude has been found that fascial grafts of some sort or another have been definitely indicated and successfully used. Lately (19) the reports of the results of fascial sutures or grafts have been discouraging but we believe the fault lies not in the grafts or sutures used but in the improper selection of the cases and in the lack of proper evaluation of the anatomical structural weakness found by the operator. In marked structural weakness of the tissues composing the floor of the canal particularly of the fascia transversalis the fascial strips or sutures are of greatest value in correcting the defects present.

It is our purpose to emphasize certain points in the technique described because they are forgotten, misinterpreted or misapplied in the proper physiological corrections of hernial defects in the inguinal regions with the subsequent failures and recurrences. First the inguinal floor presents variations in structural contour which are too

many to discuss in this short article. We refer the readers to a recent paper by Anson and McVay in which the variations are described and the frequent areas of structural weakness are pointed out and discussed. At the time of operation when the floor is exposed it should be thoroughly inspected and studied to the end that the weak areas discovered be properly taken care of later in the process of reconstruction of the wall. The fallacy of the conjoint tendon as an unfailingly strong pillar that can be used as the main axis in the proper repair of the floor of the inguinal canal is clearly brought out and dispelled by the workers quoted. These workers as well as Andrews and Seelig (12, 17) have brought out that the weakness of the floor of the inguinal canal is frequently found in its medial aspect designated by Andrews as the inguinal triangle. Second the internal oblique muscle fibers found in the inguinal canal are part of the roof of the canal and their use in rebuilding the floor by suturing them to Poupart's ligament is considered unphysiological. The muscle will not remain strongly attached at the place where it is sutured as union takes place only between the connective tissues of the muscle fibers the epimysium and the ligament. The union of muscle fibers is relatively stronger in tensile strength than the union of muscle to fascia or white connective tissue. Therefore it is essential that like tissues be placed in contact in order to obtain the strongest and most sturdy physiological final fusion in the repair. Third the application of tension in bringing tissues together should be avoided. The use of relatively strong fine silk sutures is the ideal inasmuch as these are

of sufficient strength to hold the approximated tissues together, and are weak enough to break in case unnecessary tension is made. Fourth, after the indirect sac is opened a thorough digital examination of the under surface of the floor should be done to help in correlating the facts observed in the study of the floor anteriorly. Fifth, the complete removal of all peritoneal sacs in the direct and indirect positions is of paramount importance. The dissection of the direct locule or locules takes little additional time and the danger of opening or damaging the urinary bladder is negligible if proper care is used. If the bladder wall is accidentally opened, it should be immediately repaired by suturing the rent. If there is no complicating cystitis or urinary infection, no drainage of the operative wound is indicated and as a rule healing of tissues takes place by primary intention. The insertion of an indwelling catheter in the bladder for 48 hours is very desirable following an accident like this. In our series of cases in 2 instances the urinary bladder was accidentally opened and immediately closed, both patients making an uneventful recovery, the wounds healing by primary intention. As a rule, after complete dissection of the sacs and converting them into one, it is possible to twist the peritoneal sac and easily insert a purse string suture at its base. The stump left after amputation of the excess sac, if this has been properly dissected, retracts backward and upward for an inch or more.

TECHNIQUE

The steps of the operation are illustrated in Figures 4 to 9. The usual incision for inguinal hernia is made exposing the aponeurosis of the external oblique muscle which is incised over the middle of the canal down to the external ring and reflected from its muscle attachment. The cord is grasped taped, and mobilized, excising the excess cremasteric fibers. The floor of the canal is then found to be clearly delineated and its weak areas and defects are observed (Fig 4). The indirect locule is identified, dissected sharply and bluntly from its attachment to the cord and under brim of internal muscular ring. The sac is opened and any adherent viscus or omentum to its inner surface is released. One or two fingers, depending on its size, is introduced into the sac and palpation of the under surface of the floor is done, thus supplementing the observations made by external inspection. Gently the indirect sac is pulled upward and laterally (Fig 5), exposing the deep epigastric vessels and preperitoneal adipose layer which are dissected and displaced medially. This is done with the idea of "indirectizing,"

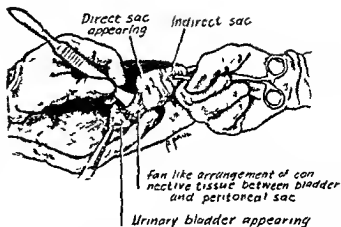


Fig 6 Dissection has progressed. All direct sacs or locules have been dissected free. Notice the fan like arrangement of peritoneum and bladder wall at this stage.

all sacs of the direct variety present, that is, changing the direct locules into the indirect position, anatomically speaking. The remnants of the embryonic hypogastric artery (lateral umbilical ligament) appear as the dissection continues medially and the edge of the urinary bladder is encountered a few centimeters beyond this embryonic structure. The bladder wall is held taut with a hemostatic forceps by the assistant who exerts slight traction medially and upward, exposing a sort of fan like arrangement of the areolar tissues between the peritoneal sac and bladder wall (Fig 6). The peritoneum is further dissected from the bladder wall and soon it is found that there is no convexity but just a straight peritoneal fold extending downward and backward. By following the lines of cleavage between the bladder wall and peritoneum and by exercising gentleness, tearing through the sac is seldom and the bleeding negligible. The sac is then twisted and its base is pursed with a doubled fine silk suture. The sac is excised, the stump as a rule retracting approximately one inch. We are opposed to transfixion of the stump of the sac as to do this is to admit the inadequate removal of the sac. The only exception is in sliding hernias in which the complete mobilization of the sac is not possible without compromising the blood supply of the attached bowel. In rebuilding the floor of the canal the muscle fibers of the internal oblique and transversus are retracted exposing the underlying fascia transversalis (Fig 7).

Seelig (16) has pointed out his difficulty in identifying the fascia of the transversus at times, and we occasionally have had similar experiences. The first suture with fine black silk rebuilds the internal ring proper by bringing the muscle fibers

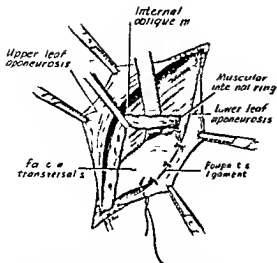


Fig 7 First stage of repair. Fascia transversalis has been attached to Poupart's ligament. Notice the first suture next to the cord which is muscular. This is the first fascial floor mentioned in operation. Internal oblique muscle is retracted.

of the transversus and oblique muscles to a shelf of these same muscle fibers which are always found attached to the undershell of Poupart's ligament just caudal to the outlet of the cord (Fig 7). At this stage if there is a dome like relaxation of the fascia transversalis in the inguinal triangle or true diverticulum this is cleaned a purse string

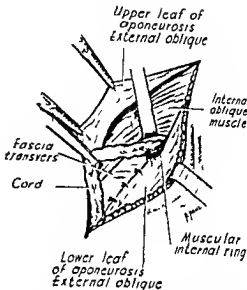


Fig 8 Second stage of the repair. The lower aponeurotic flap has been tacked on the fascia transversalis. This is the second fascial floor. The muscle is still retracted.

suture is inserted and inverted as suggested by Andrews and Bissell (3). Continuing with interrupted fine black silk sutures the fascia transversalis is brought without tension to the shelving edge of Poupart's ligament thus creating the first fascial layer of the floor in reconstruction. Then the lateral or outer leaf of the aponeurosis of the external oblique is attached with the same type of sutures to the upper surface of the fascia transversalis allowing sufficient space so that the cord is not constricted or kinked thus forming the second fascial layer of the new floor (Fig 8). The retracted internal oblique muscle is allowed to fall in place and the medial leaf of the aponeurosis is tacked down to the lower leaf, thus making the third fascial layer of the floor of the canal (Fig 9). Above the internal ring the edges of the aponeurotic leaves are approximated with a few interrupted sutures. A new floor has been created which is structurally strong and of sufficient resiliency to withstand any stress placed upon it from within. The cord is dropped in its new bed and the fatty subcutaneous layer and skin are closed in the usual manner. The cord as it will be noticed assumes finally an extra aponeurotic position.

UNUSUAL ANATOMICAL VARIATIONS

If there is a large femoral ring the fascia transversalis should be attached to Cooper's ligament instead of the shelving edge of Poupart's ligament following the technique described by Dickson. In

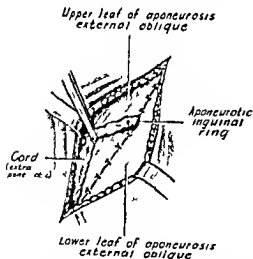


Fig 9 Last stage of the operation. The oblique muscle has been allowed to fall in normal place. The upper aponeurotic leaf has been attached to the lower aponeurotic leaf creating a third fascial layer of the newly reconstructed floor. The cord finally is placed extra aponeurotically.

a few cases in which weakness or incompleteness of the floor is still present after attaching the fascia transversalis to Poupart's ligament due to frailness, severe relaxation, attenuation or absence of the fascia transversalis, then the use of strips of fascia lata may be advantageously used to re enforce and correct the weak area (1, 10, 11). This procedure takes but a few minutes with the help of a Grace or Maxson's fascial stripper. In very large defects the use of fascial pedicle graft is obvious and the procedure of choice is that described by Wangenstein (18). One of us has been quite successful in using the femoral canal for the passage of the mobilized iliofemoral tract pedicle graft. This type of graft as a rule is sutured to the under surface of the rectus muscle, thus replacing or re enforcing the fascia transversalis. The Kirschner fascial patch graft does not produce as strong and resistant a wall, in our opinion and experience, as does the fascial pedicle graft.

SUMMARY AND CONCLUSIONS

1 The complete removal of the peritoneal sac with all its locules, the approximation of like tissues which have been properly mobilized to avoid tension, are considered of paramount importance in the successful repair of hernias.

2 The usual operations for indirect hernias are considered inadequate, as is indicated by the frequency of recurrences, mainly because of the incomplete eradication of the direct locule or locules of peritoneal sacs present and because of the unphysiological repairs made by the approximation of tissues which histologically and physiologically are different.

3 A single flexible surgical method of repair of inguinal hernias has been described, which is applicable to all types of defects in the inguinal regions not excluding the recurrent hernias. The rare variations necessary at times are described in the body of the article.

4 The occurrence of simple, indirect hernias (monolocular) is relatively rare after the age of 30 years.

BIBLIOGRAPHY

- 1 ANDREWS EDMUND A method of herniotomy utilizing white fascia. *Ann Surg* 1924 80 225
- 2 Idem Further experiences with purely fascial herniotomy. *Ann Surg*, 1928 88 874
- 3 ANDREWS EDMUND and BISSELL ARTHUR D Direct hernia. *Surg Gynec & Obst* 1934 58 753
- 4 ANSON BARRY J and McVAY CHESTER B Inguinal hernia: the anatomy of the region. *Surg Gynec & Obst* 1938 66 186
- 5 BICKHAM WARREN STONE *Operative Surgery*, Vol IV p 138 Philadelphia W B Saunders Co, 1924
- 6 COLEY WILLIAM B Keen's *Surgery* Vol IV p 17 Philadelphia W B Saunders Co 1914
- 7 DICKSON A R Femoral hernia. *Surg Gynec & Obst* 1936 63 665
- 8 ERDMAN SEWARD A Textbook of Surgery Edited by Frederick Christopher Philadelphia W B Saunders Co, 1936
- 9 FOSTER GEORGE V The use of fascia lata in the repair of hernias. *Surg Gynec & Obst* 1936 63 632
- 10 GALLIE, W F, and LE MESURIER A B Living sutures in operative surgery. *Canadian M Ass J*, 1927, 11 504
- 11 Idem Transplantation of fibrous tissues in repair of anatomical defects. *Brit J Surg*, 1924 12 280
- 12 GRAY HENRY Anatomy of the Human Body Philadelphia and New York Lea & Febiger 1924
- 13 LEWIS DEAN Nelson's Loose Leaf Living Surgery Vol IV p 597 New York Thomas Nelson & Son 1927
- 14 MOSCHCOWITZ A V Femoral hernia a new operation. *New York State J Med* 1907 7 306
- 15 NILSSON JOHN R Hernia in industry. *Surg Gynec & Obst* 1937 64 400
- 16 SEELIG, M J Fundamental principles underlying the operative cure of inguinal hernia. *J Am M Ass* 1927 88 529
- 17 SEELIG M J and CHOUKE K S A fundamental factor in the recurrence of inguinal hernia. *Arch Surg* 1923 99 816
- 18 WANGENSTEIN O H Repair of recurrent and difficult hernias and other large defects of the abdominal wall employing iliofemoral tract of fascia lata as pedicle flap. *Surg Gynec & Obst* 1934 59 766
- 19 ZIMMERMAN LEO M Surgical treatment of direct inguinal hernia. *Surg Gynec & Obst* 1938 66 193

A SAFE SURGICAL SPONGE

EDWARD F LEWISON M.D. New York New York

THE loss of a surgical sponge is a most deplorable accident. Yet the medical literature has shown an almost complete indifference toward this operative catastrophe. The development of operating room procedures to contend with this problem has been for the most part a measure of prophylaxis. The sponge count, the use of stick sponges, the metal clipped or ringed laparotomy pads, the wire threaded sponge, the sponges on a string and the continuous sponge are all important precautions primarily designed to prevent the losing of a surgical sponge. The meticulous regard with which the surgeon and his assistants are trained to convey each free piece of gauze placed within the operative field is a tribute to the care and caution needed to preclude the possible inclusion of a tampon within the incisional closure. Despite these measures some of which are inadequate and objectionable and others cumbersome, lost surgical sponges and laparotomy pads remain a rare but corrigible cause of grief after operation.

The problem of the missing sponge will continue to be a surgical hazard regardless of the virtues of the many present plans of prophylaxis as long as individual sponges are so used. Fundamentally the safety of a lost surgical sponge must exist in the ease and manner of its redemption and the facility with which it can be rapidly recognized, localized and readily retrieved.

Interest in this problem was stimulated several years ago when a patient was admitted to the Johns Hopkins Hospital with a persistently draining sinus 1 year after an appendectomy. The diagnostic possibility of the presence of a gauze foreign body was naturally pre-eminent yet the hazards of an operative exploration were considerable thus making the problem a difficult one.

Of approximately 27,250 abdominal operations performed at the 'Mayo Clinic' over a 5 year period 13 were for the removal of a gauze foreign body. As statistical accuracy is rather difficult to obtain it may be reasonably assumed that a certain number of retained sponges may be com-

patible with good health and similarly a certain number responsible for early death after operation.

These and similar experiences have prompted this investigation for a reliably redeemable surgical sponge. The character and extent of this research have resulted in the experimental use of all the known radio opaque substances in the hope of producing a safe surgical sponge which might be readily detected on an x-ray film. Inasmuch as ordinary cotton gauze casts no x-ray shadow it was not until the recent advent of glass fiber in the manufacture of fabrics that a practical and satisfactory solution to this problem was found. By incorporating into the gauze mesh a single strand of glass thread specially prepared with a predetermined lead content a surgical sponge harmlessly inert and of marked radio opacity was produced. Whether the introduction of lead glass thread will have an even more extensive use in the future field of surgery is at present difficult to say. However further study along such lines is now in progress.

MATERIALS AND METHODS

Thus with the objective well in mind—that of finding a safe and satisfactory tampon that would cast a permanent x-ray shadow—a systematic search to investigate each of the many well known radio-opaque contrast media was begun. Attention was first directed to the iodides because of their relatively high radio-opacity and the frequency with which they are so employed. Several small squares of sterile gauze mesh were first immersed in solutions of sodium iodide of various strengths namely 7½, 15, 25, 50 per cent and a saturated solution. These squares were carefully sutured in sequence to the parietal peritoneum of a dog and x-ray films were taken at weekly intervals to determine the opacity of the shadows cast. It was found that all shadows disappeared in a period of 4 weeks and the time of disappearance varied directly with the strength of the solution used. The factors responsible for this loss of radio-opacity in so short a span of time are speculative. However it may be assumed that the sodium iodide entered into solution with the surrounding body fluids and was rapidly diffused throughout the body.

From the Division of Surgery, Northwestern Medical School and Tassan Memorial Hospital and the Department of Pathology, Johns Hopkins Hospital.

Dr. Lewison was located formerly in Chicago.
Masson J.C. An extra tag on the abdominal pad. J Am Med Assn 919 72 22



Fig 1



Fig 2



Fig 3

Fig 1 Film taken February 1938 1 month after placing a lead glass threaded sponge within the peritoneal cavity of a dog. The arrow points to the single strand of lead glass fiber in the left upper quadrant. The gauze mesh of the sponge casts no x ray shadow.

Fig 2 Film taken May 1938 4 months after placing

the sponge. The arrow points to the lead glass fiber.

Fig 3 Film taken September 1938 8 months after placing the sponge. The arrow again points to the lead glass fiber. The 2 additional strands of lead glass thread which are visible in this film are being used to determine tissue reaction.

Further studies of a similar nature, making use of barium, bismuth, thorium, iodized oils, and lead weighted silk, in a series of 4 experiments using 2 dogs were made but with disappointing results. Characteristics of the undesirable effects of these materials were (1) rapid loss of radio opacity, (2) marked tissue reaction, (3) loss of absorption quality of the gauze mesh, and (4) difficulties relating to the physical properties of the contrast media used. These serious objections were sufficient to make their use inadvisable.

As previously mentioned, the recently extended use of glass thread, made by forcing potassium silicate through many minute holes with high pressure steam jets in the field of textiles, has given added zest to the successful solution of this problem. Sample fibers of glass thread were obtained for experimental study. Ordinary glass thread, however, cast no x ray shadow, yet it seemed that this material was admirably well suited for its intended purpose. Its pliancy, delicacy, and high tensile strength, in addition to its



Fig 4

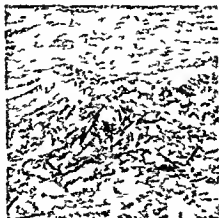


Fig 5

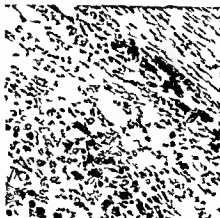


Fig 6

Fig 4 Section of rectus muscle 48 hours after implanting a large thread of lead glass fiber. Oval space at top of section represents site at which thread was placed. Moderate leucocyte tissue reaction. X80.

Fig 5 Section of subcutaneous tissue 1 month after implanting a thread of lead glass fiber. Low grade tissue reaction marked connective tissue proliferation. X100.

Fig 6 High power magnification of section shown in Figure 5. Characteristic mononuclear cellular response. Fibroblastic activity indicates reparatory process. X400.



Fig. Roentgenogram of the right upper quadrant of an obese female. The lead glass thread is clearly defined between a gall stone and residual barium in the large bowel.

negligible cost of production were factors of considerable importance. Further study found it possible to alter the chemical composition of the glass thread. By the addition of lead to the potash silicate a strand of glass thread could be produced of such radio opacity that the x ray shadow cast was of a density equal to that of bone. It was then feasible to interweave a single strand of this lead glass thread composed of innumerable minute fibers 0002 of an inch in diameter into a small square of gauze mesh and place it within the abdominal cavity of an experimental animal. X ray films were taken at bi weekly and then monthly intervals over a period of 8 months to determine its permanence and opacity.

After 1 month (Fig. 1) the x ray film showed clearly the presence of the lead glass threaded sponge in the upper left quadrant of the dog's abdomen. Four months later (Fig. 2) the film revealed no appreciable change in the thread's radio opacity and from the shadow cast it could hardly be confused with any other structure in

the body. At the end of 8 months a lateral film (Fig. 3) again confirmed the permanence of the opaque shadow and gave no evidence of its possible loss of contrast density. This gave rather conclusive proof that radio opaque lead glass thread retained a remarkable longevity and could be used expediently in this capacity should its other properties prove desirable.

The 2 additional strands of lead glass thread that strikingly stand out in Figure 3 were placed within the abdominal wall to determine the tissue reaction of this thread. Blocks of rectus muscle and subcutaneous tissue were resected at intervals of 1, 2, 7, 14, 30 and 240 days. A section through the rectus muscle (Fig. 4) 2 days after implanting a heavy piece of lead glass thread reveals only a moderate leucocytic infiltration in the adjacent muscle. The tissue reaction seems well localized and no greater considering the incident trauma than that stirred up by catgut of a similar size. Glass thread like glass is a relatively inert substance and would be expected to cause a minimum amount of tissue reaction. After 30 days (Figs. 5 and 6) a section of abdominal subcutaneous tissue clearly illustrates the glass thread fragmented in the preparation of the section and the low grade mononuclear cell infiltration that is present. New connective tissue proliferation is conspicuous and is an important part of the animal's reparatory process.

Figure 7 represents the radio opacity of a lead glass threaded sponge when filmed through the tissues of an obese female. The thread is clearly defined when contrasted with the opacity of a gall stone above and residual barium in the large bowel below.

SUMMARY

The lost surgical sponge is frequently a disastrous mishap. Because the present methods of sponge control are only partially satisfactory, this investigation was undertaken in the hope of providing a readily recognizable safe gauze tampon. All of the commonly known radio opaque materials were exploited to this end and none found to be practically expedient. A specially prepared product, namely lead glass thread, was found to embody these qualities: marked radio-opacity, permanent radio-opacity, minimum tissue reaction, negligible cost of production, chemical inertness, pliancy, delicacy and appearance resembling white silk thread. As a result a single strand of lead glass thread may be interwoven in surgical gauze mesh and the presence and location of the lost sponge determined with facility.

Mr H. P. Hood and Mr G. V. McCauley, Corning Glass Co., were most helpful in preparation of lead glass thread.

EDITORIALS

SURGERY Gynecology and Obstetrics

FRANKLIN H. MARTIN
Founder and Managing Editor
1905-1935

LOYAL DAVIS, EDITOR

Associates

SUMNER L. KOCH MICHAEL L. MASON

DONALD C. BALFOUR, *Associate, Editorial Staff*

NOVEMBER 1939

HARVEY CUSHING

THE Editors of SURGERY, GYNECOLOGY AND OBSTETRICS join the surgical world in sorrow over the death of Harvey Cushing. As a stimulating investigator both in the laboratory and at the bedside, he had the ability to record his experiences in a fascinating style which made him equally famous as an author as a surgeon and scientist. No other single individual in recent years has exerted such a profound influence upon the art of surgery.

UNUNITED FRACTURES OF NECK OF FEMUR

NON UNION of central or intracapsular fractures of the neck of the femur is of frequent occurrence, despite the universal accessibility of modern roentgenographic equipment and improved methods of surgical treatment. Because of the mechanical and physiological status of this region, non union may be expected

in approximately 10 per cent of cases, regardless of the efficiency of the treatment employed. The majority of ununited fractures at this point, however, arise from failure to make a diagnosis and from inefficient treatment. Since the revival and improvement of internal fixation, the proportion of successful results has been materially increased, but these procedures are still too often inaccurately applied by those who have not mastered the operative technique.

Non union is reached much sooner in fractures of the neck of the femur than in fractures elsewhere. When reduction is not accomplished early, there is a wide separation of the fragments and, from a practical point of view, non union is present at the end of four weeks. Union has been induced by reduction alone after the elapse of three months, though such a result is exceedingly rare.

Until recent years non union was a hopeless condition, now, however, a large percentage of patients can be assured a useful extremity with partial or complete restoration of function by operative measures. The object of all operations for ununited fractures of the neck of the femur is restoration of an osseous support for the upper extremity of the femur and elimination of shearing action at the site of fracture. This is accomplished by two methods: first, by inducing union at the fracture site, when feasible, and, second, by some reconstructive measure which will place the lower extremity directly beneath the pelvis, to provide an osseous support for weight bearing on the longitudinal axis of the femur. The surgical procedures employed for these purposes are as follows: (1) internal fixation by metal, (2) internal fixation by metal and bone

graft (3) internal fixation by bone graft, (4) reconstruction operations (5) osteotomies

Internal fixation by the first three methods is designed to secure union at the point of fracture. The technique of these procedures is well known. The earlier the operation is undertaken the greater the likelihood of excellent functional and anatomical results.

The reconstruction operations consist of the remodeling of the upper extremity of the distal fragment with or without removal of the head of the femur and restoration of the leverage action of the abductor muscles. By the Brackett operation, the upper extremity of the distal fragment is remodeled the greater trochanter removed and the lower fragment displaced inward to approximate the head, the trochanter with the abductor muscles intact is fixed to the lateral surface of the shaft of the femur at a lower level. The Whitman reconstruction differs from this only in that the head is excised and the remodeled upper extremity of the lower fragment is placed within the acetabulum. Colonna excises the head, severs the tendons of the abductor muscles, places the trochanter with its tendinous investment within the acetabulum, and inserts the detached muscles at a lower level on the femoral shaft. Albee excises the head, performs a longitudinal osteotomy of the upper extremity of the femur, displaces the fragment with the greater trochanter outward, and inserts a wedge graft, usually the head of the femur into the space thus created to maintain the bone muscle lever in a lateral position.

The osteotomies are of two types the high and the low or Schanz. In the high osteotomy, the femur is severed in the region of the lesser trochanter and the lower fragment is displaced beneath the head of the femur and across the line of fracture as a living graft. The extremity is then immobilized in abduc-

tion, thus producing an angle between the two fragments. By this procedure shearing action is eliminated and union is often induced at the point of fracture, with restoration of almost normal function. Otherwise, the upper extremity of the lower fragment approximates and receives osseous support from the pelvis which usually gives a fairly serviceable member. The low, or Schanz, osteotomy is carried out at the level of the tuberosity of the ischium and the lower fragment is abducted to induce inward angulation, the upper fragment is supported by the lateral aspect of the pelvis eliminating shearing force at the site of non union. The chief objection to this measure is the fact that undue strain is placed on the internal lateral ligament of the knee which in some cases leads to genu valgum deformity.

The indication for these procedures varies according to the age and physical condition of the patient and the local status of the fracture. Operations undertaken soon after non union is established offer a much better prospect of a functional hip, since, with the passage of time, the fragments undergo atrophic changes and the neck is gradually absorbed. If operation is delayed therefore, the possibility of restoring normal anatomical relationships is commensurately decreased. The non viability of the head cannot be accurately determined from the roentgenographic demonstration of an increased density of the head alone unless the structure is practically opaque. The head is normally dense and does not undergo atrophic changes so rapidly as the surrounding bone, further, if the head is atrophic prior to fracture, there will be little or no contrast between the head and the adjacent bones.

Restoration of anatomical contour is of course desirable. If the structure of the bone is good and the head viable, internal fixation as of fresh fractures is advisable and frequently can be accomplished by blind nailing. This

procedure may be employed in many cases until the elapse of approximately three months. After atrophic changes and pseudo arthrosis are established, the insertion of a bone graft, with or without metallic fixation, is preferable. This often requires exposure and denudation of the ends of the fragments. In the presence of extensive atrophic changes, internal fixation of any type must be followed by immobilization in plaster casts and braces for a period of six to twelve months. Such prolonged immobilization not only is a physical handicap, but also may impose a serious financial burden upon the patient. If his economic status will permit and his physical condition is good, anatomical conformity and practically normal function may be anticipated. Other procedures, however, which do not require such long confinement, give results which compare favorably with those of internal fixation.

Reconstruction operations, with the exception of the Brackett reconstruction, are employed only in the presence of extensive atrophic changes in the bone or a non-viable femoral head, with or without absorption of the neck. These procedures are followed by failure in a large number of cases, and even when successful, the functional results do not equal those obtained by internal fixation or osteotomy. The Brackett operation is not advisable if the head has undergone aseptic necrosis.

High osteotomy is especially indicated in the aged and debilitated if absorption of the neck is not extensive, osseous union may often be induced, with excellent function. Even if union fails to take place, a support is provided which permits weight bearing without crutches and gives a result comparable to that of a reconstruction operation. The low, or Schanz, osteotomy is most suitable when absorption of the neck is extensive and the head necrotic,

or when reconstruction operations have failed. Osteotomies are particularly advantageous in that they cause less surgical shock than any other procedure and, with the exception of that incident to early internal fixation, the period of confinement is shorter.

In conclusion, the most important factor in the treatment of ununited fractures of the neck of the femur is the determination of the state of non-union as early as possible, since the sooner operative measures are instituted, the more successful the outcome. When feasible, internal fixation by metal or by bone graft, and high osteotomy, give the best functional results. After absorption of the neck or necrosis of the head, reconstruction operations, with or without excision of the head, or low, or Schanz, osteotomies are the procedures of choice. Whatever the local condition, when the measures devised for this purpose are judiciously employed, the prognosis of ununited fractures of the neck of the femur is far more favorable than in the past.

WILLIS C CAMPBELL

TOTAL CYSTECTOMY FOR CARCINOMA OF THE BLADDER

FROM the points of view of maintenance of normal physiological functions, choice of therapeutic procedure, operative risk, and likelihood of ultimate cure, the management of carcinoma of the bladder presents many more problems than the treatment of carcinoma in most other parts of the body. In contrast with carcinoma of the breast, kidney, uterus, and many other organs, wherein the indications for treatment and method of attack are relatively standardized and widely accepted, each case of carcinoma of the bladder presents a distinctly individual therapeutic problem. Not only must the function of the bladder be preserved or some suitable provision made if the bladder

is removed entirely, but even more important is preservation of renal function and the prevention of serious renal infection.

Choice of the ideal therapeutic procedure for the individual patient who has a vesical neoplasm depends on a number of factors: the type, grade of malignancy, extent and exact location of the lesion, whether the uretero-vesical orifice on one or both sides has been encroached on, the status of renal function, the presence or absence of important renal infection, and of great importance, the age and general condition of the patient. Obviously when so many factors must be considered almost all of which are necessarily dependent on personal interpretation for their relative evaluation, there is ample opportunity for difference of opinion regarding the choice of therapeutic procedure. This fact together with the numerous methods of treatment which are available in the management of carcinoma of the bladder have added to the difficulty of standardizing forms of treatment and evaluating end results obtained by various procedures. The mature clinical judgment which is necessary in selecting the most desirable type of treatment must be learned largely by experience. Gradually during the last 25 years, as the many problems involved have become more clearly appreciated, certain facts and general principles in the treatment of vesical carcinoma have evolved. During this period experience with total cystectomy has grown but the exact indications, most desirable method of execution, and results that might be anticipated in a large series of well selected cases, remain to be accurately determined. That complete removal of the bladder has a definite place in the management of vesical carcinoma, however, cannot be denied.

The indications for total cystectomy have undergone a gradual change during recent

years. In the past this procedure was almost uniformly reserved for the advanced, extensive, high grade lesion, possibly recurrent in nature, which could not possibly be treated with any expectation of cure by less radical measures. In cases of this type, extension of the lesion beyond the confines of the bladder and even distant metastatic growths were undoubtedly often present, although perhaps unappreciated, at the time when the bladder was removed. Under these circumstances satisfactory results were not obtained and could not be expected, and consequently the operation failed to gain wide favor. At the present time it is believed that total cystectomy has a different field of usefulness and is frequently contra-indicated in the type of case just mentioned. One does not have justification for the performance of so extensive a staged procedure without reasonable hope of ultimate cure.

It is now realized that an extensive, relatively low grade carcinoma too large to be dealt with satisfactorily by transurethral measures and which would require for its adequate removal almost complete resection of the bladder by the suprapubic approach, probably constitutes one of the ideal indications for total cystectomy. Likewise a repeatedly recurring low grade lesion which has resisted conservative forms of treatment, or one which apparently has multiple foci of origin, comparable to the extensive carcinomatosis sometimes seen in association with polyposis of the colon, may offer a suitable indication for total extirpation of the bladder. The high grade, infiltrating type of lesion which to the best of one's knowledge has not progressed beyond the bladder, may best be treated in this same manner. In addition to these types of cases in which the indications for total cystectomy may appear to be fairly definite, there are other cases in which in the judgment

of the individual surgeon, complete removal of the bladder may be considered the treatment of choice

The general plan of procedure in the performance of total cystectomy will vary depending on the exact findings in the individual case and the experience of the surgeon. It is now well recognized that the risk of operation is definitely higher when grossly dilated and otherwise abnormal ureters are transplanted into the bowel. In general, ureterosigmoidal transplantation is wisely reserved for the ureter of normal or relatively normal size, although exceptions may be made. In contrast, the risk is lower and the results are better if cutaneous ureterostomy is employed when considerable ureterectasis exists.

Whether total cystectomy is best accomplished in one, two, or three stages will depend on the conditions found in the individual case, on the type of ureteral transplantation that is contemplated, and on the surgeon who is performing the operation. In former years three stages were commonly employed when ureterosigmoidal anastomoses were established. Each ureter was transplanted separately and subsequently the bladder was removed. In general, three major operations performed on a patient suffering from cancer are not desirable. Simultaneous bilateral ureterosigmoidostomy can be performed in well selected cases with reasonable operative risk. It is the opinion of many that the two stage procedure, with initial transplantation of both ureters into the bowel, and two or three weeks later removal of the bladder, is usually the best plan of procedure. In contrast, if the ureters are to be transplanted to the skin and if there appears to be urgent need for extirpation of the bladder, the entire operation can be performed in one stage by an experienced surgeon with

reasonable risk. A safer plan of procedure for the average surgeon, however, is initial bilateral cutaneous ureterostomy and subsequent removal of the bladder.

It would be only a slight exaggeration to say that there are almost as many methods for performing ureterosigmoidal anastomosis as there are surgeons who perform this operation. Because of this fact the technical procedures involved in the transplantation of the ureters into the bowel will not be discussed. The essential features which all endeavor to embody in their own particular operation are a sepsis, and lack of tension, angulation, or obstruction, either temporary or permanent, where the ureter traverses the wall of the bowel. Appropriate preoperative and postoperative care is essential for the best results.

It has been implied that the patient who has undergone total cystectomy is not in condition to lead a normal and useful life. This implication can be definitely and truthfully denied. Transplantation of the ureters into the bowel works little hardship on the patient and is not at all incompatible with a normal, active life. Control of the bowel content is satisfactory, provided that the rectal sphincter functions normally. In addition, the patient may be spared repeated cystoscopic examinations and other procedures which are often necessary during a prolonged period of years (if he survives) following less extensive forms of treatment. Cutaneous ureterostomy, it is true, does not create an ideal state of affairs, but is comparable in its disagreeable features to colostomy, which has been an accepted operation for many years. When possible, of course, transplantation of the ureters to the bowel rather than transplantation to the skin is to be desired.

JAMES T. PRIESTLEY

CORRESPONDENCE

PROFESSOR ARCHIBALD YOUNG

1874-1939

AMERICAN surgery on July 23 1939 lost a dear friend and an eminent colleague in the death of Archibald Young regius professor of surgery at the University of Glasgow Professor Young was born in Glasgow and went through all his schooling in that vicinity He graduated from the University of Glasgow with distinction and following this went through a long period of hospital training finishing as senior assistant to Sir William MacEwen who then held the chair which Professor Young himself was later to decorate

Archibald Young was imbued with a high ambition and followed the finest ideals of surgery He was a most industrious person When he achieved his appointment in 1924 as regius professor of surgery at the University of Glasgow he set about to maintain for the Glasgow school that eminent place in surgery which it had held from the days of Lister and which had been visioned ever since Peter Lowe returned from France and founded the Faculty of Physicians and Surgeons of Glasgow Dr Young busied himself in many fields including the operative treatment of fractures skin grafting peptic ulcer

and for several years before his death he made special contributions to the field of the surgery of the sympathetic nervous system

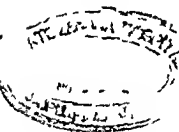
He not merely was a teacher of surgery but in addition to serving both in the South African War and in the Great War was a fine citizen in the City of Glasgow and assumed positions of importance in civilian life

Professor Young's qualifications led him to acquire great distinction He became a member of the Royal Academy of Physicians in Rome He was an honorary fellow of the American Surgical Association of the American College of Surgeons and of the Academy of Surgery Philadelphia He received the degree of Doctor *honoris causa* from the University of Strasbourg and was an honorary member of the Academy of Surgery of France His ambition was to stimulate the advancement of scientific surgery by the unselfish collaboration of many workers and all his life he strove to provide the opportunity for useful work to those willing to undertake research

Professor Young's many friends in America will miss his sincere and stimulating nature and send their sympathy to his widow and two children one of whom is a young doctor

ELLIOTT C CUTLER M D

Boston Massachusetts



THE SURGEON'S LIBRARY

REVIEWS OF NEW BOOKS

IN his introduction to *Chronic Diseases of the Abdomen, a Diagnostic System*,¹ Marshall says, "in this work, which of course does not pretend to be an encyclopedia of abdominal disease an attempt is made, while omitting no important condition in the diagnostic problem in any given entity, to assess at their real value the observations in history, clinical, laboratory and other special examinations, which may be utilized to arrive at dependable conclusions." In a large measure Marshall has attained this objective. The first 52 pages are devoted to methods of examination. The section dealing with history taking contains some valuable advice. The guide to the general physical examination which Marshall refers to as the "diagnostic net from whose meshes no big pathological fish can escape" is excellent. The last 155 pages deal with differential diagnosis of abdominal conditions considered first from the standpoint of pain, both general and regional, and second from the standpoint of significant symptoms including hematemesis, ascites, variations in appetite, weight loss, jaundice, diarrhea, hematuria, vomiting, and pyrexia. The illustrations are pertinent but only fair in quality.

The book stamps its author as a thoughtful surgeon with wide clinical experience. The reviewer wishes the author had differentiated better the symptomatology of the right and left sides of the colon and regrets the extent of the reference, even guarded as it is to Glenard's disease. The book cannot fail to be valuable to students and practitioners and stimulating to specialists. FRISCHER CHRISTOPHER

THE *Essentials of Modern Surgery*² is an English textbook edited by Handfield Jones and A. E. Porritt with the co-operation of 13 of their colleagues. The authors have attempted to produce a textbook of surgery which will neither be a comprehensive product of two or more volumes, nor a short text in one volume with easily assimilable material with which the student can satisfy the examiner. The purpose of the authors is to put forth a volume in which surgical teaching is based on the fundamentals of anatomy, physiology, and pathology, thereby building a sound foundation upon which the student as well as the practitioner can think for themselves, rather than subject every patient to countless laboratory investigations.

Detailed operative treatment is only rarely included in this book, although the nature of the treatment is well given. The book divides itself into 47 chapters with 501 illustrations, the latter always exceedingly helpful to the average student and practitioner. Many of the divisions are excellent. 'Infections of the Hand and Fingers' is perhaps better stated than in most textbooks in use at our medical schools and the Kanavel influence can be sensed immediately. The chapter on "Diseases of the Blood Vessels" is especially well handled, while the questions of hernia and appendicitis deserve special commendation. Those interested in "Injuries and Diseases of the Nerves" will find a fine presentation, unlike that found in any textbook of surgery. It is of interest to note that in the discussion of post-operative paralytic ileus, a galaxy of drugs are offered, but no mention is made of the Wangenstein suction method which to this reviewer is perhaps the greatest adjunct to our armamentarium in fighting this dreadful complication. There is a scholarly dissertation on drainage in peritonitis which should be read not only by medical students but all interested in this much mooted question.

The book is a worthy addition to the many fine textbooks on surgery among which it will find its proper place, but this reviewer can name several American books equally as good if not better.

EARLE I. GREENE

THE second edition of Dr. Major's book *Classic Descriptions of Disease*,³ which has become a standard volume in all medical libraries, contains new sections covering certain diseases not previously described. Dr. Major has collected classic accounts of diseases and has added interesting biographical sketches of each author as well as revising many of those in the previous edition. The text contains numerous interesting and instructive illustrations and should be included in every physician's library.

J. ROSCOE MILLER

IN a book of 47 chapters Dr. Scudder has organized *The Treatment of Fractures*⁴ in a very methodical manner. Measurements of normal and abnormal joint functions are discussed and illustrated. First aid, transportation, and extension are dealt with in a comprehensive manner. Naturally the author is not

¹CHRONIC DISEASES OF THE ABDOMEN: A DIAGNOSTIC SYSTEM. By C. Jennings Marshall. M.S. M.D. (Lond.) F.R.C.S. (Eng.) Boston Little Brown & Co. 1930.

²THE ESSENTIALS OF MODERN SURGERY. Edited by R. M. Handfield Jones M.C. M.S. F.R.C.S. and A. E. Porritt M.A. M.Ch. F.R.C.S. Baltimore: William Wood & Co. 1931.

³CLASSIC DESCRIPTIONS OF DISEASE WITH BIOGRAPHICAL SKETCHES OF THE AUTHORS. By Ralph H. Major M.D. 2d ed. Springfield Ill. and Baltimore Md. Charles C. Thomas 1930.

⁴THE TREATMENT OF FRACTURES. By Charles Locke Scudder. A.B. Ph.D. M.D. F.A.C.S. 11th rev. ed. Philadelphia and London W. B. Saunders 1933.

able to go into minute details with each fracture as volumes could be written rather than chapters yet the subjects are well covered and important points are stressed

Fractures from birth injury on have been discussed as to pathology complications and method of treatment This book is well illustrated with x ray views diagrams and microscopical photographs The chapter on anesthesia is most commendable and very pertinent especially in view of present day multiple and serious injury Spinal injuries with and without cord involvement are of particular interest though I believe this section could have been discussed a little more extensively since spinal injuries constitute a very important subject about which little is known and which is worthy of weighty consideration The chapter on intervertebral disc injuries is stimulating and of paramount importance in view of our inadequate knowledge on this subject Operative work has been stressed but obviously cannot be extensively discussed or illustrated

All fractures from the head to the toes have been handled and discussed very well Each chapter is definitely enlightening in the short space allotted it I believe that all fractures and their treatment have been either touched upon or emphasized and while some forms of treatment are controversial I believe the author has selected the most representative type of treatment for each

In addition to having all the essentials necessary for a good fracture book, this treatise has a very valuable chapter on the medicolegal relations in fractures supplying a great present day need in view of the fact that most traumatic work entails court appearances This adjunct completes what in my opinion is the best most practical and enlightening fracture book of the present day While I do not agree with all methods of treatment advocated I must say that there are certain definite outstanding points in every chapter of this book that should be of great assistance to the student and practitioner

JAMES J. CALLAHAN

BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender Selections will be made for review in the interests of our readers and as space permits

OXFORD MEDICAL PUBLICATIONS PIONEERS IN ACUTE ABDOMINAL SURGERY By Zachary Cope B.A. M.D. M.S. (Lond.) F.R.C.S. (Eng.) London Oxford University Press 1939

ILLUSTRATIONS OF REGIONAL ANATOMY By E. B. Jameson M.D. Sections I-VII 2d ed. Baltimore The Williams and Wilkins Co. (American distributor) 1939

CLÍNICA QUIRÚRGICA EN LAS ENFERMEDADES COSTALES PLEURALES By Pedro D. Curutchet Buenos Aires Argentina Librería y Editorial El Ateneo 1939

MATERNAL CARE AND SOME COMPLICATIONS THE PRINCIPLES OF ANTEPARTUM INTRAPARTUM AND POSTPARTUM CARE AND OF THE MANAGEMENT OF SOME SERIOUS COMPLICATIONS Approved by The American Committee on Maternal Welfare Inc. Edited by F. L. Adair M.D. Chicago The University of Chicago Press 1939

ESQUENA DE RODILLA By Dr. Manuel Pérez Zabala Buenos Aires Argentina Sebastián de Amorruutzu e Hijos 1939

STERILIZATION A HANDBOOK FOR PHYSICIANS HOSPITAL EXECUTIVES AND NURSES By Hurley T. Wyatt M.S. 2d rev. ed. Madison Wis. Scanlan Morris Co. 1936

THE RHYTHM OF STERILITY AND FERTILITY IN WOMEN By Leo J. Latz A.B. B.S. M.D. LL.D. 6th rev. ed. Chicago Latz Foundation 1939

PRACTICAL OBSTETRICS By P. Brooke Riland M.D. and Thaddeus L. Montgomery M.D. 3d rev. ed. Philadelphia F. A. Davis Co. 1939

THE ROCKEFELLER FOUNDATION INTERNATIONAL HEALTH DIVISION ANNUAL REPORT 1935 New York The Rockefeller Foundation 1939

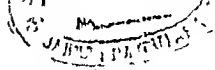
OFFICE GYNECOLOGY By J. I. Greenhill B.S. M.D., F.A.C.S. Chicago The Year Book Publishers, Inc. 1939

DE PRIMAIRE MAARRESCHTDE BIJ DOORGEBOREN MAAR EN DOORONTZWEVEN By Dr. M. J. Kingma Assen Holland Van Gorcum & Comp. N.V. 1939

GYNECOLOGIC OPERATIONS AND THEIR TOPOGRAPHIC ANATOMIC FUNDAMENTALS By Prof. Dr. Med. Heinrich Martius Authorized English translation under editorial supervision of W. A. Newman Dorland A.M., M.D. F.A.C.S. Chicago S. B. Debour Publishers, 1939

ANESTHESIA VARIANTS LOCAL, REGIONAL, SPINAL By A. M. Dogniotti M.D. Authorized English Translation by Carlo S. Suderi M.S. M.D. F.A.C.S. Chicago S. B. Debour Publishers, 1939

REGAIN YOUR FIGURE HOW TO RECOVER THE FITTER AFTER CHILD-BIRTH WITHOUT STRENGTHENING EXERCISES By Lt. Col. J. K. McConnel D.S.O. M.C. With a Foreword by Cedric Lane Roberts M.S. F.R.C.S. F.C.O.G. Cleveland Ohio The Sherwood Press 1939





Engraving by H. Cook

Thomas Linacre

1460 1524

SURGERY

GYNECOLOGY AND OBSTETRICS

An International Magazine, Published Monthly

VOLUME 69

DECEMBER, 1939

NUMBER 6

ASPIRATION OF AMNIOTIC FLUID BY THE FETUS

An Experimental Roentgenological Study in the Guinea Pig

W F WINDIE, M S, Ph D, R F BECKER, M S, E E BARTH, M D and
M D SCHULZ, M D, Chicago Illinois

ALTHOUGH it is commonly said that the fetus is apneic *in utero*, this concept has been challenged from time to time. Some investigators hold that it exercises its breathing mechanism before the end of gestation. How extensively fetal respiration like movements occur under normal physiological conditions is the subject of some controversy at present.

No one doubts that mammalian fetuses can perform rhythmical movements of their respiratory muscles long before birth but these may be due to asphyxia or at least to conditions involving a higher degree of anoxemia in the fetal brain than normally obtains there. Such movements are commonly seen when the uterus of a pregnant laboratory animal is opened. The literature contains many reports all of which we shall not review here. Human fetuses show the movements in question as early as the twelfth week of gestation when the placental exchange is interrupted (23). On the basis of similar observations one may be tempted to entertain a false conception of respiration at birth as a continuation of respiration like motor phenomena indulged

in normally by the fetus throughout fetal life. This is contrary to fact.

Using the cat as an experimental animal, we (24) were able to demonstrate that fetuses are apneic *in utero* during the third quarter of gestation (the gestation period lasts 65 to 69 days in the cat) but they respond to increasing the carbon dioxide and decreasing the oxygen tensions in their blood with rhythmical respiration like movements. In our experiments, anesthesia was avoided, the pregnant animals having been decerebrated by ligating the carotid and basilar arteries according to the method of Davis and Pollock (16) an hour or more before experiments were begun. The cat experiments were confirmed in incubating eggs of the chick and duck (25, 26, 27). It was possible to control physiological conditions more precisely in the bird than in the mammal. A comparison of our studies with those of Romijn and Roos (18), who have determined the oxygen and carbon dioxide content of the atmosphere breathed by the chick (egg air space), shows that the occurrence of respiratory movements is associated with anoxemia.

Other investigators have studied the respiration like activities of young mammalian fetuses. Barcroft and Barron (3) saw such

From the Departments of Anatomy and Radiology, Northwestern University Medical School.
Dr. Windie was aided by a grant from Child Neurology Research (Friedsam Foundation).

movements in the sheep and one of the present authors (W T W) had the good fortune to observe some of their experiments. Although it may be thought that their observations support the view that fetuses normally are not apneic *in utero*, these authors avoided such conclusion. They considered the possibility that 'some as yet ill understood stimulation of the fetus' started them. At any rate the movements made their appearance under experimental conditions and one has no way of knowing if they occur normally in the intact sheep. The ewes had been anesthetized with urethane or had been given a spinal anesthetic before the experimental cesarean sections were performed. The first respiration like movements of 38 to 40 day old fetuses may have been set off by mechanical pressure upon the amniotic sac. Later spontaneity of the rhythmical movements became more pronounced but stimulation still facilitated their observation. In at least one instance they were observed through the wall of the transilluminated but manipulated uterus. In another study from the Cambridge laboratory (5) it has been shown that at the tenth week of gestation the fetal blood drawn anaerobically from the umbilical vein of exposed goat fetuses is no more than 60 per cent saturated with oxygen, percentage saturation increasing with age to the seventeenth week. If the young sheep fetus does appear to be breathing continuously *in amnio* it may be because its blood like that of the goats studied under similar experimental conditions, was deficient in oxygen. That is the experimental conditions may have led to anoxemia. Spontaneous movements of a respiratory nature are no longer seen when sheep fetuses reach about 50 days gestation age (4) and the unborn lamb near term is singularly quiet in the unopened uterus. Correlatively, it has recently been shown that the umbilical vein blood drawn without opening the uterus often exceeds 90 per cent saturation with oxygen (6).

What other evidence is there for the belief that respiration at birth is simply a continuation of respiration like activity occurring normally before birth? Ahlfeld (1) started a lively discussion of this question more than half a century ago when he described certain

activities of the human fetus which he could observe by watching the abdomen of the mother in the latter part of gestation. Many expressed doubts that these were truly of a respiratory nature. In 1905, he (2) published excellent graphic records that can leave no question in our minds that what he saw resulted from rhythmical movements of fetal respiratory muscles. Reifferscheid confirmed his observations but concluded that the movements did not necessarily cause amniotic fluid to be aspirated by the fetus. Recently Snyder and Rosenfeld (20) have produced motion pictures of these human fetal respiratory phenomena. They hold them to be physiological and to bring about a flow of amniotic fluid into and out of the fetal lungs *in amnio*, even suggesting that such aspiration may assist in opening the lung aveoli preparatory to air breathing at birth. Be that as it may for the moment the outstanding fact of the case is that human fetal respiration like movements are only rarely seen and when they are they appear at very infrequent intervals. This is similarly true in certain other mammals that have been studied recently.

Snyder and Rosenfeld (21) described rhythmical respiration like movements in late fetal life of other mammals principally rabbits. The pregnant animals were submitted to spinal cord section previous to experiments and the abdomens were opened in a bath of warm saline solution to allow direct observation of the intact uterus. Analysis of their data shows that intermittent rhythms of activity were seen in somewhat more than 19 per cent but less than 56 per cent of their specimens. The majority of the rabbit fetuses studied were at term (31 days) or were postmature, the gestation period having been prolonged hormonally one or more days. It is probable that the post mature fetuses failed to obtain a normal oxygen supply and may have shown respiratory movements for this very reason. Koff and Davis reported that the fetuses of rabbits in which labor was inhibited by similar methods failed to live beyond the thirty-sixth day of gestation. Perhaps they died of asphyxia. On the other hand in the untreated specimens at term there can be no doubt that

respiration like rhythms do manifest themselves occasionally. Snyder and Rosenfeld have informed us that they were able to see what appeared to be respiratory movements in fetuses in a few unoperated upon, untreated rabbits, near term.

Bonar and Blumenfeld repeated some of the experiments to which we have referred. They stated: "We have come to the conclusion that intra uterine respiratory movements of the fetus occur, that they are physiological, and that they are not initiated by asphyxial changes in the fetal blood nor by stimulation as a result of handling." Proof is lacking for such a broad statement.

Recently we have examined more than 25 perfectly healthy, unoperated upon, pregnant cats and guinea pigs carrying normal litters near term and have not been able to observe clearly defined respiration like movements. It seems clear to us that such activities must be less prevalent than we formerly believed (22). However, it is sometimes possible to palpate and to see fetal movements of a respiratory nature without opening the abdomen of a decerebrate cat (24). They are infrequent, inconstant, and not in all animals are they manifested. After the uterus has been delivered, the cat submerged in a bath of warm Ringer Locke solution, they can be seen to good advantage. The longer the uterus has been exposed, as a rule, the more frequently the fetal activities in question occur. Great caution must be exercised in evaluating results of experimentation.

Blood gas analyses have been made from samples withdrawn from the umbilical veins of cat fetuses delivered from the uterus but still with placental circulation intact (22). It was found that the content of oxygen was low, not exceeding about 50 per cent saturation in the blood of specimens which were executing rhythmical respiratory movements at the time of sampling. It has not been possible to obtain samples from the umbilical veins without incising the uterus and consequently we do not know what the oxygen level is *in utero*. However, it was apparent that the veins darkened very quickly upon delivering a cat fetus and before we could draw blood from them. Fetal respiratory efforts often

began at that time. In the human at normal birth when apnea prevails but respiration starts readily, the umbilical vein blood is about 50 per cent saturated with oxygen (11). Some higher values have been obtained at cesarean section (11) and at normal delivery (8) in the human. In the cow, too, a higher degree of oxygen saturation seems to prevail (19). The sheep fetus a few days from term is apneic *in utero* and correlatively, its umbilical vein blood, obtained without removal of the lamb from the uterus, is highly saturated, exceeding 90 per cent in some (6). But when the lamb is delivered in a saline bath with placental circulation intact, the blood becomes reduced until it is only about 35 per cent saturated in the fetal carotid artery (7). In the bird respiratory movements normally begin several days before hatching at the time when the atmosphere of the egg air space, into equilibrium with which the "avian placental" blood comes, has become reduced in oxygen to about 13 volumes per cent while the carbon dioxide has increased to 6.5 volumes per cent (18). The figures for fertile unincubated eggs are about 20 volumes per cent and 1.5 volumes per cent, respectively.

These facts seem to indicate that the fetus is apneic *in utero* (or *in ovo*) so long as it is receiving a certain adequate amount of oxygen and is giving up carbon dioxide satisfactorily. When and if the fetal requirements exceed the placental capabilities in these respects the fetus may respond with rhythmical movements of a respiratory nature. That the conditions for fetal respiration like activities are occasionally met in what appears to be the normal course of events prior to birth can not be doubted. However, there is no proof that they are ever met in all or even in the majority of individuals.

Granting that respiration like movements can and do occur occasionally *in utero* toward the end of gestation, what is the evidence that the fetus aspirates its amniotic contents? Others have pointed out that dyes injected into the amniotic sac can be observed in the fetal lungs after removal of the fetuses (20, 28). In none of these experiments have anoxic conditions been rigidly ruled out of consideration. It is known that vernix caseosa



Fig. 1. The abdomen of the pregnant guinea pig was opened after infiltrating the tissues with 1 per cent procaine on the sixty third day of gestation. Amniotic fluid was withdrawn from the sacs of the two fetuses and replaced with an equivalent amount (0.8 c.c.m.) of thorotrast in A and thorad in B. The pregnant animal then was allowed to breathe an atmosphere low in oxygen and high in nitrogen. Aspiration like rhythms of fetal movements were observed through the uterine wall in B but were not so clearly seen in A. The roentgenogram taken half an hour later shows the bronchial tree well filled with thorad in B but not in A.

is sometimes found in the lungs of infants which have survived birth a short time. However Farber and Sweet in a large series of autopsies with microscopical study found that only 13 per cent of the lungs of human infants surviving birth for 3 weeks or less contained significant amounts of debris ascribable to fetal aspiration of amniotic contents.

RESULTS

We wish to report at this time some new experiments bearing upon the question of aspiration of amniotic fluid. Taking our cue from Ehrhard who recently demonstrated fetal swallowing by means of roentgenograms taken after injecting thorotrast into the amniotic sac of one human subject, we have studied a series of guinea pigs during the last week or two of gestation. The procedure follows. The pregnant animals were tied to an operating board upon their backs and the position of the fetal heads determined by palpa-

TABLE I—FETAL ASPIRATION IN EXPERIMENTAL ANOXEMIA

No.	Age (days)	Ga. breathed	Fetal respiration observed	Presence of asphyxia
1	63	Nitrogen	+	+
2	63	Nitrogen	+	+
3	60	Nitrogen	+	—
4	64	Nitrogen	Slight	—
5	64	Nitrogen	Slight	—
6	62	Nitrogen	?	—
7	66	Nitrogen	?	?
8	60	Nitrogen	?	+
9	67	Nitrogen	+	—
10	67	Nitrogen	?	—
11	67	Nitrogen	?	—
12	61	Rebreathing	+	+
13	61	Rebreathing	Weak	—
14	62	Rebreathing	Weak	—
15	65	Nitrogen	+	—
16	65	Nitrogen	+	+
17	65	Nitrogen	+	+
18	63	Nitrogen	—	—
19	63	Nitrogen	+	+
20	63	Nitrogen	?	?
21	67	Carbon dioxide	+	+
22	67	Carbon dioxide	?	+
23	58	Carbon dioxide	Slight	+
24	58	Carbon dioxide	Slight	—
25	52	Carbon dioxide	—	—

1 project, 2 no were m det, 3 is ta, 4 malis, 5 24 d tl paral my
sum la 51 25

tion. Without an anesthetic we were able to pierce the abdominal and uterine walls with a thin (No. 27) hypodermic needle. Usually from 0.4 to 1 cubic centimeter of amniotic fluid was withdrawn and an equal amount of a colloidal solution of thorium hydroxide or dioxide (thorad or thorotrast¹) was injected to replace it through the same needle. In a few instances the material was injected without withdrawing any amniotic fluid. The injection was made as near the nostrils and mouth of the fetus as possible, often we could feel the teeth with the tip of the needle. After injection roentgenograms were obtained within a few minutes, a few hours, and then at daily intervals until birth.

Results can be described very briefly. Twenty-seven fetuses (20 pregnant guinea pigs) 51 to 72 days gestation age (birth usually occurs between 63 and 68 days in this species) were treated as indicated. In 10 of these, only 1, 2, or 3 films were taken and exposures were made only within the first few hours after thorium hydroxide or dioxide

We wish to acknowledge the assistance of the General Electric X-ray Corporation and the H. J. C. Chemical Corporation who supplied the material for experimental purposes.



Figs 2 and 3 Experiment similar to that in Figure 1 but using 1 cubic centimeter of thorad in two amniotic sacs on the sixty seventh day of gestation. The pregnant animal then breathed an atmosphere with a high carbon

dioxide content. Figure 2 is a roentgenogram taken 40 minutes later. It shows the bronchial tree in fetus A and the trachea in B outlined by the thorad which was aspirated. Figure 3 taken after removing the fetuses is confirmatory

had been introduced. In the 17 other fetuses, the material was present in the amniotic sacs for periods varying from 24 hours to 14 days and from one to many exposures were made at daily intervals or less. In no instance could trachea, bronchi, or lungs be seen in the roentgenograms although the opaque substance could be observed in the fetal stomach within an hour or more by virtue of the fact that it had been swallowed.¹ We concluded that the fetuses either had not aspirated the thorium hydroxide or that this substance was too dilute when drawn into the lungs to cast a shadow on our films. These results were similar to those obtained by Ehrhard in his one 6 month human fetus which showed no lung shadow. Menees, Miller and Holly (10, 15) apparently found the same if we may judge from an illustration showing the fetal stomach filled but the chest without shadows. Menees and his colleagues, who pioneered in amniography, used a solution of strontium iodide instead of thorotrast. Access to six

human roentgenograms taken after using diotrast (on the service of Dr Cornell at Passavant Hospital) failed to demonstrate any shadows of the respiratory tract. However, strontium iodide and diotrast are of much less value than thorotrast for our present purpose. We would emphasize the point that in our own experimental animals conditions were as nearly normal as we would make them. No anesthesia was used, excessive palpation was avoided, only very small quantities of a material which does not pass through membranes and seems to be quite inert were used, and usually this was administered in such a way that no change in fluid volume in amnio was effected. The significance of our negative results will become apparent from the experiments which follow.

To test the questions raised by these observations we performed another series of 25 experiments in 18 fetuses (12 pregnant guinea pigs) 52 to 68 days gestation age. In 14 experiments, initial conditions were exactly like those outlined, but in the 11 other experiments injections were made after the mother's

¹We shall deal with the subject of fetal swallowing and gastro-intestinal activities in another article to appear in this journal in the near future.



FIGS. 4 and 5. One cubic centimeter of thorotrast replaced a similar volume of amniotic fluid withdrawn from one sac of an unanesthetized guinea pig on the sixty-third day of gestation. Figure 4 is from the film taken on the sixty-sixth day. It shows clear lungs but thorotrast in the intestines. The guinea pig died 5 days after the injection and the fetus whose amniotic sac contained the thorotrast was recovered at autopsy. Figure 5 shows heavy shadows of the thorotrast-filled lungs.

abdomen had been opened following procaine infiltration of tissues. In all 25 experiments after injection had been made the pregnant guinea pigs were subjected to procedures designed to change the gas tensions of the fetal blood. Usually films were exposed before such changes had been effected. All such films showed the fetal respiratory tracts clear. Following this the pregnant animals were allowed to breathe atmospheres high in nitrogen or carbon dioxide or were forced to rebreathe air from a rubber glove placed over the head. The fetuses became active in consequence of these procedures and we could usually observe rhythmical fetal movements resembling respiration although it was frequently very difficult to be certain of the nature of these activities. Subsequently, roentgenograms were obtained again to determine whether or not aspiration of the thorium hydroxide had occurred. Table I summarizes the results of these experiments made with animals.

It will be seen that the lungs were more prone to fill with the material when injected at laparotomy than when given to the intact animals. Interference with uterine vascular channels may have added to the severity of the anoxemia in these experiments. In the 14 experiments showing weak, questionable slight or no fetal respiratory movements of a rhythmical nature only two definite fillings of the fetal respiratory tract occurred. In the 12 remaining experiments all showing fetal respiration like rhythms clearly, 7 perfectly definite and positive results were obtained.

Three additional experiments, not included in the 25 just mentioned, throw light on the question of the aspiration by the fetus. In one the amniotic sac was injected with 0.8 cubic centimeter thorotrast on the sixtieth day of gestation. X-ray films subsequently demonstrated that the fetal respiratory tract contained no opaque material. During the following day the guinea pig appeared to be in labor which was prolonged throughout the

morning. Death of the mother occurred at noon without delivery. A roentgenogram of the fetus at this time revealed the lungs filled with thorotrast. In another instance 1 cubic centimeter thorotrast was added to the amniotic fluid of one fetus on the sixty third day of gestation. Films taken thereafter revealed no lung shadows (Fig 4). The mother died during the night 5 days later without delivering the fetus. A film of the fetus subsequently demonstrated that the fetal lungs had become filled with thorotrast (Fig 5). Finally, 2 of 4 fetuses in the uterus of one animal were injected on the sixty first day of gestation. Three roentgenograms taken on the sixty first, sixty second, and sixty third days showed the lungs of both fetuses to be perfectly clear. Birth occurred on the sixty fourth day. One of the injected fetuses was born alive and the other failed to breathe at birth. The lungs of the living fetus were perfectly clear (Fig 6a), while those of the one failing to breathe after birth had become filled with thorotrast as may be seen in Figure 6b.

ANALYSIS OF RESULTS

It would seem from these experiments that aspiration of amniotic contents does not occur normally in the guinea pig fetuses but that it may be brought about under conditions of asphyxia. It is furthermore suggested that not all fetal movements which appear to be rhythmical and resemble respiratory activity serve to bring about aspiration of amniotic fluid. There is no reason to think that conditions of placental exchange are very different in the guinea pig and man but just how far one can go in the direction of interpreting human fetal respiratory behavior in terms of our present experiments is problematical. Certainly it may be said that the presence of vernix, laguno hair, or other debris in the lungs of the human newborn is unphysiological. It is very doubtful if amniotic fluid can be aspirated without bringing such debris into the respiratory tract. The Farber and Sweet studies have indicated very clearly that lungs of few infants, even of those surviving birth but a few hours, contain vernix caseosa. It is reasonable to assume that in the few cases in which vernix appeared in the



Fig 6 Thorotrast was placed in the amniotic sacs of two fetuses on the sixty first day of gestation without using anesthesia. Daily roentgenograms showed that the lungs of neither fetus contained any of the material although it was present in the gastro intestinal tract. Birth occurred on the sixty fourth day. Fetus A was alive at birth and its fur was found coated with meconium and thorotrast. Its lungs were clear. Fetus B died without breathing at birth. Its lungs were filled with the thorotrast. Considerable time elapsed between birth and the exposure of these films and the living pig A had had time to pass whatever thorotrast remained in the gastro intestinal tract at birth.

lungs, respiratory acts had been induced prematurely by some unphysiological condition. From our experience with guinea pigs it would seem that inhalation of gases which induce anoxemia may lead to prenatal aspiration of amniotic contents. The implication is that asphyxial types of anesthesia may do the same.

Since we found experimentally that the lungs do not invariably become filled with fluid when the guinea pig fetus executes rhythms of movements resembling respiration, it may be taken that in the human, too, the observation of Ahlfeld's fetal respiration like movements before labor sets in does not necessarily signify that the fetus is aspirating amniotic fluid. However, the prevalence of such fetal behavior should be looked upon with apprehension because we know that it may mean inefficiency in the placental

exchange mechanism which can lead to anoxemia and consequently aspiration of vernix caseosa. If the human, like other mammalian fetuses is normally apneic *in utero*, and responds as they do to oxygen deficiency and carbon dioxide accumulation, there is no reason to doubt that fetal respiration like movements do signify that fetal needs are not being met advantageously.

CONCLUSIONS

1. Intra uterine rhythmical respiration like movements of guinea pig fetuses were not observed under normal physiological conditions.

2. Thorotrast or thorad introduced into the amniotic fluid about the head of the fetal guinea pigs in late prenatal life was not aspirated by the fetuses when physiological conditions prevailed.

3. When fetuses were induced to execute rhythms of respiration like movements during experimental anoxemia the amniotic fluid containing thorotrast or thorad was aspirated in some but not all instances. Similarly, difficulty in labor with consequent fetal asphyxia led to aspiration of amniotic fluid by the fetuses in several instances.

LITERATURE CITED

1. AHLFELD F. Ueber bisher noch nicht beschriebene intrauterine Bewegungen des Kindes. *Verhandl d deutsch Gesellsch Gynaek* 1885 2: 201-209.
2. Idem. Die intrauterine Taetigkeit der Thorax und Zwerchfellmuskulature. *Intrauterine Atmung*. *Monatschr f Geburtsh u Gynaek* 1905 21: 143.
3. BARCROFT J and BARROW D H. The genesis of respiratory movements in the fetus of the sheep. *J Physiol* 1936 88: 56-61.
4. Idem. Movements in mid fetal life in the sheep embryo. *J Physiol* 1937 91: 329-351.
5. BARCROFT J, ELLIOTT R H, E. FLENNER L B, HALL F G, HERKEL W, MCCARTHY E F, McCURKIN T and TALAT M. Conditions of fetal respiration in the goat. *J Physiol* 1934 83: 192-214.
6. BARCROFT J and MASON M F. The atmosphere in which the fetus lives. *J Physiol* 1938 93: 22.
7. BARCROFT J, KRAMER K and MILLIKAN G A. The oxygen in the carotid blood at birth. *J Physiol* 1939 94: 571-578.
8. BIDONE M. Il contenuto in ossigeno e acido carbonico del sangue dei vasi ombelicali del feto umano etc. *Ann di ostet e ginec* 1931 53: 197-213.

9. BONAR B L and BLUMENFELD C H. Obstetrical anesthesia. I. A laboratory method for studying the effects of anesthetic and analgesic agents on both the uterus and fetus. *Surg Gynec & Obst* 1938 66: 170-185.
10. CASE J T. Obstetrical and gynecological roentgenography. Chap 98 in *Curtis Obstetrics and Gynecology* 1933 3: 762-867. Philadelphia W B Saunders Co.
11. EASTMAN N J. Fetal blood studies. I. The oxygen relationships of umbilical cord blood at birth. *Johns Hopkins Hosp Bull* 1930 47: 221-230.
12. FIRRHARD K. Der Irinkende Foetus. *Muenchen med Wehnschr* 1937 84: 1699-1700.
13. FARRER S and SWEET L K. Amniotic sac contents in the lungs of infants. *Am J Dis Child* 1931 42: 1372-1383.
14. KOFF A K and DAVIS F M. The mechanism of the prolongation of pregnancy in the rabbit. *Am J Obst & Gynec* 1937 34: 26-37.
15. MENEES T O, MILLER J D and HOLLY L E. Amniography. *Am J Roentgenol & Rad Therapy* 1930 24: 363-366.
16. POLLOCK L J and DAVIS L. Studies in decerebration. I. A method of decerebration. *Arch Neurol & Psychiat* 1924 10: 391-398.
17. REIFFERSCHIED K. Ueber intrauterine Atembewegungen des Foetus. *Arch f d ges Physiol* 1911 140: 1-16.
18. ROUJY C and ROOS J. The air space of the hen's egg and its changes during the period of incubation. *J Physiol* 1938 94: 365-379.
19. ROOS J and ROUJY C. Some conditions of fetal respiration in the cow. *J Physiol* 1938 92: 249-267.
20. SNYDER F F and ROSENFIELD M. Intrauterine respiratory movements of the human fetus. *J Am. M Ass* 1937 108: 1946-1948.
21. Idem. Direct observation of intrauterine respiratory movements of the fetus and the role of carbon dioxide and oxygen in their regulation. *Am J Physiol* 1937 110: 153-166.
22. STEELE A G and WINDLE W F. Some correlations between respiratory movements and blood gases in cat fetuses. *J Physiol* 1939 94: 531-538.
23. WINDLE W F, DRACSTEDT C A, MCKEAY D E and GREENE R R. A note on the respiration like movements of the human fetus. *Surg Gynec & Obst* 1938 66: 987-988.
24. WINDLE W F, MONTER M and STEELE A G. Fetal respiratory movements in the cat. *Physiol Zool* 1938 11: 425-433.
25. WINDLE W F and BARCROFT J. Some factors governing the initiation of respiration in the chick. *Am J Physiol* 1938 121: 684-691.
26. WINDLE W F, SCHARPENBERG L G and STEELE A G. Influence of carbon dioxide and anoxemia upon respiration in the chick at hatching. *Am J Physiol* 1938 121: 692-699.
27. WINDLE W F and NELSON D. Development of respiration in the duck. *Am J Physiol* 1938 121: 700-707.
28. WISLOCKI G B. Experimental studies on fetal absorption. I. The vitally stained fetus. *Contr to Emb* 1920 11: 47-53.

AN EXPERIMENTAL STUDY OF URETERO-INTESTINAL IMPLANTATION

II The Significance of the Normal Uretrocloacal Arrangement in Some Reptiles and All Aves

FRANK HINMAN, A B, M D, F A C S, WILLIAM K. MURPHY, M D, and
HENRY M. WEIRAUCH, JR., A B, M D, F A C S,
San Francisco, California

AS AN approach to the surgical problem of uretero intestinal anastomosis, the normal structure of the ureterocloacal entrance, as found in some reptiles and all birds, has been investigated. Examinations were made of gelatin injections, gross preparations, and microscopic sections of the urinary cloacal tract in the alligator, chicken, duck, turkey, and ostrich. In 6 chickens and 2 ostriches the entire intramural extent of the ureter was sectioned serially. All of the animals studied exhibited similar anatomical structures, but the following description refers specifically to chickens weighing approximately 3 pounds.

Ureter. The ureter averages 2 millimeters in diameter and 6 centimeters in length. Taking origin from a ventrally located renal pelvis it pursues a retroperitoneal course to transverse the wall of the cloaca and empty into the urodeum by way of orifices which are situated in the dorsolateral aspect of the vestibule. As the ureters approach their intramural extent they gradually converge to the ureterocloacal orifices which are located about 1 centimeter apart (Fig. 1).

Upon histological examination, the ureter is found to be composed of 3 layers, the mucosa, the muscularis, and the adventitia, progressing from the lumen outward (Fig. 2). The mucosa demonstrates the most striking peculiarity of these animal phyla. Instead of the usual transitional type which is found in mammals, the mucosa is composed of columnar epithelium, a formation which is continued

throughout the renal pelvis. The muscularis is made up of interlacing bundles of more or less distinct outer circular and inner longitudinal fibers. Here and there connective tissue filaments are interspersed among the myogenic elements. In that portion of the muscularis which lies closest to the mucosa a generous supply of lymphocytes is peppered throughout the length of the ureter. This lymphoid tissue is even more profuse than that noted in the ureter of the dog or rabbit in a similar position.

Cloaca. The cloaca is divided into 3 bulbous vestibules by 2 transverse folds, the distal fold separates the proctodeum from the urodeum, the proximal one the urodeum from the caprodeum (Fig. 1B). The most distal outpouching, the proctodeum, measuring 1 centimeter in diameter and 1 centimeter in length, opens at the anus. A smaller middle chamber, the urodeum, serves as the immediate outlet for the urinary and genital systems. It is roughly 1 centimeter in diameter and 8 millimeters long. The ureters open more closely to the fold which delineates the caprodeum (2 millimeters distant) than to the one which bounds the proctodeum (6 millimeters distant). The proximal receptacle of the cloaca, the caprodeum, is 1.5 centimeters in diameter and 2.5 centimeters in length. It joins the contiguous intestine, being the first part of the cloaca to receive the intestinal excreta.

Upon microscopic section, the cloaca is found to resemble the large intestine of mammals, being composed of mucosa, submucosa, muscularis, and serosa (Fig. 3). The muscularis is subdivided into a circular inner

From the Department of Surgery, Division of Urology, University of California Medical School.

Supported in part by the Christine Breon Fund for Medical Research.

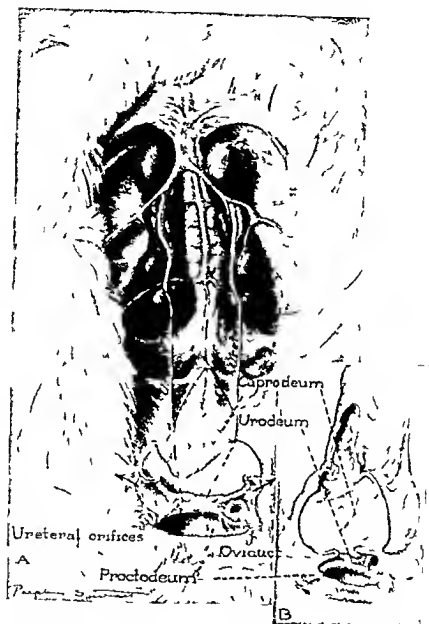


Fig 1 The urinary cloacal tract in the chicken. Inset shows the 3 vestibules of the cloaca.

layer which is the more substantial and a thinner outer longitudinal layer. The usual type of columnar epithelium forms the mucosa which is bordered by a vascular submucosa. There is a profusion of lymphoid follicles in both the mucosa and submucosa.

Ureterocloacal entrance. Serial sections of the ureterocloacal entrance show the ureter

MEASUREMENTS OF INTRAMURAL URETER

Specimen number	1	2	3	4	5	Average
L. gth in mm of intramural ureter	1	8	26	4	4	5.76
L. gth in mm of intramural ureter	4		18	0	2	1.25
Diameter in mm of intramural ureter	4	0.5	3	5	0	5.6

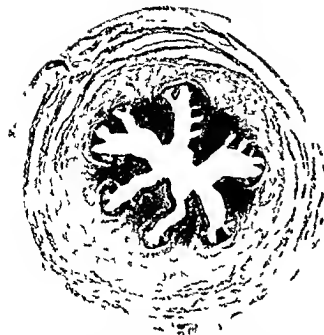


Fig 2 Upper portion of chicken's ureter. Note the columnar type of mucosal epithelium, the inner longitudinal and outer circular fibers of the muscularis and the abundance of lymphocytes in the region of the mucosa. $\times 55$



Fig 3 Chicken's ureter immediately proximal to its entry into the wall of the cloaca. Note the inner circular and outer longitudinal layers of the cloacal musculature. $\times 30$

first outside the muscularis of the cloaca (Fig 3), next transpiercing the muscularis (Fig 4), and finally coursing submucosally (Fig 5), to merge with the mucosa of the cloaca at the ureteral orifice (Fig 6). The ureter progresses for an average distance of 5.76 millimeters through the muscularis and 1.28 millimeters beneath the mucosa before opening at the orifice which is 0.54 millimeter in diameter.

It will be seen that there is a complete independence of the muscular walls of the ureter and cloaca, extensive search having failed to reveal any interchange between the two systems. The muscularis of the cloaca gives way to allow penetration of the muscularis of the ureter which extends down to the ureteral orifice where it lies in direct contact with the mucosa of the cloaca (Fig 6). Neither gross nor microscopic examination yielded any evidence of a valvular structure which might exert a rôle in closing off the ureter from the cloaca.

The anatomical features of the uretero-cloacal entrance may be summarized as follows:

1. There is a complete independence and

lack of union between the ureter and the intestinal musculature. The ureteral musculature persists in all its entirety to the orifice where it ends abruptly without any evidence of a transmurial fading out.



Fig 4 The chicken's ureter transpiercing the muscularis of the cloaca. Note the circular muscle fibers coursing around the ureter. $\times 23$



Fig 5 The submucosal course of the chicken's ureter $\times 30$

2 A columnar type of epithelium is found lining the ureter and renal pelvis as contrasted with the transitional type found in man

3 The mucosa and submucosa of the cloaca are supplied with a great abundance of lymphoid tissue, lesser amounts are seen in that part of the muscularis of the ureter which borders upon the mucosa

4 The structural arrangement at the ureterocloacal entrance gives no indication of acting as a valve

RESULTS OF STUDY

Investigation of the ureterocloacal entrance in animals which normally possess such an anatomical arrangement demonstrates a complete independence between the muscular layers of the ureter and those of the cloaca. The ureteral musculature transpierces the muscle layers of the cloaca, extends submucosally, and terminates only at the ureterocloacal orifice. There is no gradual thinning out or interchange of fibers similar to the fusion of the ureteral and vesical musculature of the human ureterovesical communication. Thus the two systems retain a relationship as



Fig 6 The ureterocloacal orifice in the chicken. Note the muscularis of the ureter extending down to the orifice and the abundance of lymphoid tissue in the adjacent cloacal mucosa $\times 30$

totally independent as if the ureter were artificially implanted. Furthermore there is no evidence of a sphincter or any type of valve formation. It is evident that a perfect result attending a submucosal type of uretero-intestinal anastomosis reproduces exactly the anatomical relationship of the normal ureterocloacal entrance. Although improvements must still be sought to assure a consistently satisfactory result after operation these findings lend encouragement to the belief that the problem is not a hopeless one.

The present study might lead one to suspect that the abundance of lymphoid tissue in the ureter and cloaca or perhaps the columnar type of ureteral epithelium, plays a protective role in guarding the avian urinary tract against infection. The possibility of such a specialized resistance of tissue or of a natural immunity to the cloacal flora will be dismissed in a subsequent communication¹.

DR. CH. HAYES M. J. and HINMAN, FRANK A. present study of the ureterocloacal orifice in the chicken. (To be published.)

ETIOLOGICAL FACTORS IN VARICOSE VEINS OF THE LOWER EXTREMITIES

JOHN C. ADAMS, M.D., Portland, Oregon

THE seeming simplicity of the injection treatment of varicose veins has evoked in the past decade a multiplicity of articles. Many of these limit discussion to the merits of favorite sclerosing agents, various bandages, and the usual assortment of pastes and promises of manufacturers, a few articles devote space to etiology. Methods of treatment have changed with increasing experience but as yet there is no generally accepted standard as to what constitutes the most adequate or satisfactory treatment, if there be such a thing. Saphenous ligation is lauded by some and condemned by others. A high percentage of recurrence is reported by many writers. That this confusion has arisen from an incomplete understanding of the cause is apparent to anyone familiar with the literature.

That proper evaluation of the hydrostatic factors in the venous system of the legs might adequately explain the frequency of varicosities at this site has been considered for many years, but numerous stumbling blocks have been encountered. Notable among the early investigators was Trendelenburg, who recognized the presence of reverse flow in varicose veins and described the test still widely used as a method for determining venous valvular incompetence. Later Delbet suggested that varicose veins might be the result of successive weakening of the valves of the saphenous system by back pressure resulting directly from increases in intra abdominal pressure. This pressure he measured by a direct method, and venous pressures as high as 260 millimeters of mercury were recorded in the leg. Through minor inaccuracies in some of his reasoning and major inaccuracies in the reasoning of some of his critics, this work of Delbet, though widely quoted and of first importance, has never been properly appre-

ciated, due apparently to some misconceptions. Murphy and Mengert, through their studies on intra abdominal pressures, have added considerable support recently to Delbet's thesis. Using a balloon in the vagina they found intra abdominal pressures as high as 200 millimeters of mercury when the patient strained. It remains to apply these latest studies to the present problem.

Several investigators anastomosed the femoral artery and saphenous vein in dogs but produced no appreciable varicosities. These studies suggested that pressure is not an important factor. Although arteriovenous anastomoses do not lead to varicosities in experimental animals, the fact remains that in humans arteriovenous fistula in the leg leads to marked varicosities in the course of a few months. This apparent inconsistency must be explained.

DeTakats et al, reported direct readings of venous pressure in the saphenous vein using a cannula and water manometer. They did not state at what point the needle was introduced into the saphenous vein, but took pressures with the patient standing, before and after saphenous ligation, and concluded that ligation produced no lasting effect inasmuch as the pressure 2 weeks after ligation was the same as it had been before. McPheeters, in his studies on hydrostatic pressures at various levels of the saphenous vein, demonstrated the effect of position, stepping, grunting (increased intra abdominal pressure), and respiration on these pressures. His results indicate definitely the direct relationship of fluid level to pressures at various points in the saphenous system, pressure increasing toward the ankle as one might expect. He did not point out, however, that this was a pure gravity effect.

The difficulty in establishing the hydrostatic pressure factor as the fundamental cause of varicose veins has apparently been the fact

From Varicose Vein Clinic, Department of Surgery, University of Oregon Medical School.

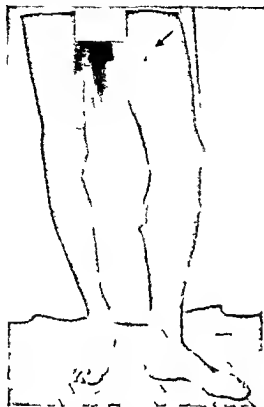


Fig. 1. Photograph in case of arteriovenous fistula about 18 months after inception. Gunshot wound visible in thigh at arrow. Note the marked dilatation of superficial venous system and pigmentation of lower leg.

that varicose veins frequently exist in the lower leg with no evidence of saphenous incompetence as judged by existing methods of examination, and marked varicosities may be present in segments of vein limited by competent valves. At first sight this appears as a logical objection and has led many investigators to discredit the back pressure theory. If the numerous discrepancies are to be explained, it is necessary to determine, first normal venous pressures in the lower extremity and, then, what factors may effect these pressures.

In approaching this problem we have used direct venous pressure determinations in the saphenous vein. The apparatus used is simple and consists of a piece of rubber tubing about 25 centimeters long in the middle of which is introduced a 5 cubic centimeter glass trap. One end is connected to a Tyco's manometer. This was chosen because of its small size and the fact that it registers pressure changes more rapidly than a mercury type manometer, thereby largely eliminating the inertia factor. An adapter which fits a Luer needle is inserted into the other end of the tubing and, after testing the joints for leakage a 15 to 17 gauge needle is connected to the adapter and inserted directly into the lumen of the vein. The

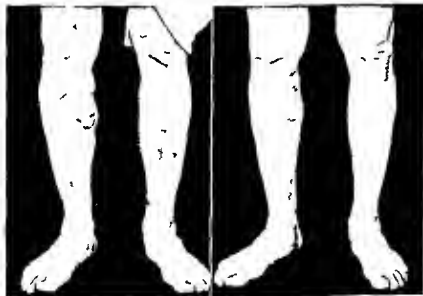


Fig. 2. Case 1 showing varicosities before and after ligation and injection. The thrombosed veins below the right knee will recede more with time.

glass trap prevents the reflux of blood into the manometer. The apparatus registers changes in pressure rapidly and its sensitivity is demonstrated by the fact that the respiratory effect is readily observed, though this amounts to only 8 or 10 millimeters variation in the chest cavity itself.

The venous pressure was recorded with the patient in the prone, sitting, and standing position. The results in 9 patients are shown in Table I. It was apparent that with the patient prone, the manometer reading was zero if the slight effect of intra abdominal and intrathoracic pressures in this position be eliminated, and this reading was not included in Table I as it is not significant. The effect of posture is immediately reflected in the manometer reading when the patient stands. We now find that the venous pressure corresponds closely to the measured height of the column of blood above our cannula point. It is this determination in which we are primarily interested.

For example. In Case 1 in the accompanying table, the actual measured standing pressure at the mid calf was 88 millimeters of mercury. By measuring the distance from our cannula point to the approximate level of the



Fig 3 Photograph demonstrating the results of water hammer effect on the saphenous vein above the sentinal valve. The dilations in the fossa ovalis simulate femoral hernias.

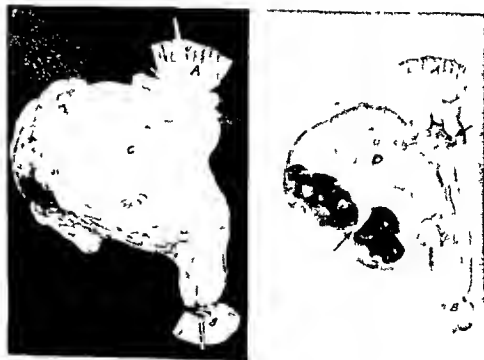


Fig 4 Specimen removed from right groin of patient pictured in Figure 3. The photograph on the left shows the large thin walled varix (C) before opening the superior end of the saphenous vein where it joined the femoral vein at A the inferior end at B. On the right the varix has been sectioned after fixation so as to expose the leaflets (see arrows) of the incompetent saphenous valve and the premortem clot D. The darker areas are merely vacuoles resulting from fixation.

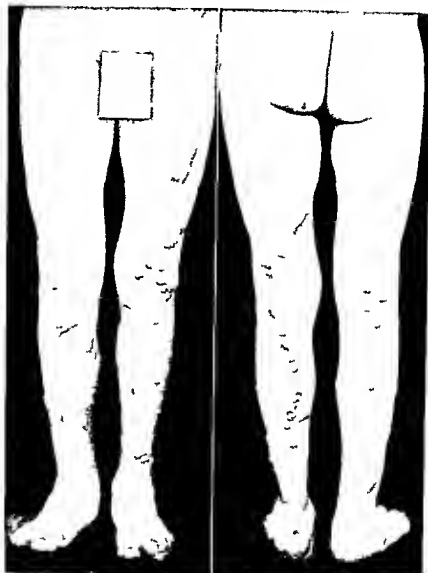


Fig 5 So called congenital angioma in a 16 year old boy involving both legs. The arterial communications in this patient must be very small as the blood pressure change increased pulse rate cardiac hypertrophy and other findings of large arteriovenous fistulas were lacking. This case demonstrates very well the communications between the greater and lesser saphenous systems.

right auricle we found that this was apparently a pure gravity effect inasmuch as reducing our column of blood to millimeters of mercury gave us a figure very close to our actual reading. Because of minor inaccuracies in measurements and other factors affecting our manometer reading, some variation is expected. These do not seem sufficient to alter our conclusion.

The significant thing about these comparisons is that they hold whether the saphenous system be competent by accepted tests or not, and whether it be varicose or normal. We have studied a sufficient number of patients to make us feel that we are correct in this point. We have not included all of our cases in Table I, but have attempted to include exemplary types. The interposition of flexible

membranes (venous valves) in a fluid system does not interfere with the transmission of pressures, provided the system fulfills the requirements of Pascal's law that it be full of fluid. This must, therefore, be true in the venous system of the leg.

The effect of increasing intra abdominal tension on our manometer is also well illustrated in Case 1. The subject was able to produce a pressure of 224 millimeters of mercury by straining in the standing position. This, in our experience, is unusually high. However, the subject was a young man of muscular build with incompetent saphenous valves. If the right auricle is considered as a sump or overflow chamber, we explain the foregoing observation as follows. As the intra abdominal pressure is increased a point is reached where the vena cava and iliac vessels are compressed. We are then dealing with a closed system of fluid which obeys Pascal's law, i.e., pressure applied to an enclosed fluid is transmitted equally in all directions and acts with equal force on equal surfaces.

It is, therefore, logical that the height of manometer pressure will depend on the patient's ability to increase his intra abdominal pressure. This explains the variations in pressure following straining as illustrated in Table I. Some patients, because of relaxed abdominal walls such as occur in women following pregnancy, or, because of inability to coordinate these particular muscular actions, are able to increase the saphenous pressure only 30 or 40 millimeters, even though the valves be in competent.

It is quite probable that numerous acts which we have not tested raise this pressure to much greater heights than we are able to record under the conditions mentioned. It is not difficult to obliterate the peripheral arterial pulse by holding one's breath and tightening the abdominal muscles so as to increase intra abdominal and intrathoracic pressure to above the systolic blood pressure. We have recorded pressures in the lower saphenous vein much higher than the systolic blood pressure for that individual. It must be remembered that our manometer records the sum of the gravity effect plus the added straining effect.

TABLE I—PRESSURE READINGS TAKEN BEFORE AND AFTER LIGATION

Case	Height of auricle above cannula cm	Actual standing pressure mm Hg	Calculated gravity effect mm Hg	Manometer reading on straining in mm Hg	Manometer reading on straining post ligation	Type of case
1 JHS ♂	111	88	85.8	224	114	Valves in competent saphenous thrill
2 HC ♂	93	68	72.6	162	72	Valves in competent saphenous thrill
3 JF ♂	89	68	69.0	148	84	Valves in competent saphenous thrill
4 EJR ♀	68	76	77.3	140	113 93	Valves in competent saphenous thrill
5 GT ♀	85	64	66.4	104	76	Varicose veins limited to lower leg negative Trendelenburg test
6 TD ♀	111	81	86.8	136	92	Valves in competent positive Trendelenburg test
7 MC ♂	84	64	63.6	98	78	See photograph and specimen
8 WW ♂	114	88	89.0	136		Incompetent
9 JG ♀	95	70	74.5	102	78	Competent varicose veins limited to lower leg

This table shows the effect of increasing intra abdominal pressure. The actual standing pressure (column 2) as indicated on the manometer corresponds closely to the calculated standing pressure shown in column 3. The standing pressure after ligation is not shown in this table inasmuch as ligation produced no change in this reading. Because of spontaneous thrombosis of the saphenous following simple ligation the post ligation pressure is missing in Case No. 8.

The saphenous system, exposed as it is without the supporting effect lent by the muscles to the deep femoral system, finds itself particularly vulnerable to these pressures. It is this constantly high gravity pressure in the erect position which leads to the rapid development of varicosities in the lower extremity when the water hammer effect of the arterial pulse acts on these veins in arteriovenous fistula. In experimental animals these pressures cannot be duplicated because the overflow sump is too close to the level of the fistula and a sufficient head of fluid does not exist. This

fact was recently confirmed by Emile Holman, who reported a venous pressure of only 37 centimeters (approximately 25 millimeters of mercury) of citrate solution in the immediate vicinity of a larger femoral fistula in a dog although the systolic blood pressure was 170 millimeters of mercury. The effect of valves on pressure is of interest. We have altered some of our ideas materially in this regard. Whereas the interposition of flexible membranes in a fluid system does not interfere with the transmission of gravity effect, it was noted in the course of these studies that competent valves modified straining pressures materially. In Case 1 where the saphenous valves were obviously incompetent, the patient was able to create a pressure of 224 millimeters of mercury with one sudden strain while in other instances, where demonstrable incompetence was not present sustained effort was required to bring the manometer to its maximum reading and this was never as high in the competent cases studied as in the incompetent ones. Our explanation of this difference is as follows:

The saphenous system is an elastic one. It reacts to increases in pressure by a stretching process which enlarges the vein capacity so that equilibrium between the venous pressure and the tension of the vein wall is preserved. This presupposes that sufficient additional blood is supplied during this process to keep the system full. While the valves are competent there is some filling occurring from below as a result of the squeezing out of capillaries and smaller venous channels by muscular action and the *vis a tergo* from the arterial side. Our figures tend to show that this filling is limited in degree. Valves then dissipate to a varying degree the effect of increased intra abdominal pressures on the saphenous system by preventing back flow. If the increased intra abdominal pressure be maintained sufficiently long, some filling occurs from below and pressure gradually rises. If valvular incompetence is present in the saphenous system back flow from the iliacs and vena cava constantly fills the system as the stretching process occurs and equilibrium is not reached until the full effect of intra abdominal pressure has been produced. The

most vulnerable part of the system is effected first whether or not competent valves are present above the particular segment involved. The lower leg is usually involved early because of the higher pressure due to additional gravity effect and the more superficial nature and less adequate mesodermal support in this portion of the saphenous system.

It seems that in man the same factors which operate to produce varicosities so rapidly in the presence of arteriovenous fistula in the leg operate more slowly but in a similar manner to produce varicosities in the absence of fistula. The same head of blood is present in both instances while the pulsing surge (water hammer effect) of the fistula is mimicked by each sudden increase in intra abdominal pressure in the simple varix. We have in fact noted in varicose veins with competent valves higher venous pressures than occur in arteriovenous fistulas.

We are not able to evaluate quantitatively that biological variation in our mesodermal structures which renders one individual more susceptible to these pressures than another. We do not question that this is an important predisposing factor. Patients with varicose veins frequently show other manifestations of so called mesodermal asthenia. Flat feet is such a common accompaniment of varicose veins that it has been considered an etiological factor by some writers. It would seem more reasonable to consider it just another manifestation of mesodermal weakness. We are probably not all constructed with the same grade of venous tubing, as these same gravity pressures exist in all of us but only a few develop varicosities. Straining pressures however are variable, and occupation, pregnancy, tumors, chronic bronchitis etc immediately assume a direct etiological relationship that is logical inasmuch as they effect these pressures.

The question, whether the stretching process is the result or the cause of valvular incompetence obviously arises. We have been impressed by the frequent visible enlargement of the saphenous bulb in the oval window and by the marked pulsation and dilatation which occurs here in some cases on coughing or other efforts which increase intra abdominal pressure. Although we did not measure this water

hammer effect, simple palpation was sufficient to indicate that it was considerable. We submit the following explanation. The result of repeated shocks is a combination of 2 factors, the valve leaflets stretch, as does the wall of the vein, and incompetence and dilatation is the result. Until incompetence results the vein below the valve nullifies a portion of this water hammer effect by dilatation, but as valves give way (Delbet) the full water hammer effect is felt by the segment of vein immediately distal to it.

We have felt that the Trendelenburg test, as usually performed, is not a satisfactory test of valvular competence, inasmuch as it takes into consideration standing pressures only. We have frequently observed patients whose valves were competent to standing pressures and so exhibited a negative Trendelenburg, yet whose valves were incompetent to the added pressure of straining and promptly exhibited a positive Trendelenburg when this factor was introduced. Consequently, we speak of a valve as being relatively competent when it withstands ordinary pressures but permits reverse flow under the added effect of strain.

If the fingers of the palpating band of the examiner be placed over the saphenous opening of the patient in the standing position, back flow in the incompetent cases is readily detected as a palpable venous thrill when the patient coughs or strains. This test takes into consideration the factor of strain as does the modification of the Trendelenburg which we have suggested. It is simple of execution. We have seen no reference to its use in the literature.

THE EFFECT OF SAPHENOUS LIGATION ON STRAINING PRESSURES

We became interested in the effect of saphenous ligation on pressure readings inasmuch as it has been an extremely controversial point in treatment. Prior to the almost routine use of saphenous ligation we had noted the frequency of recannulization of apparently well thrombosed veins and had confirmed this finding by the examination of segments of the saphenous at varying intervals following sclerosis by injection. Large blood sinuses frequently reform in 6 weeks or less, a fact which

has been observed by others. We can from our experience confirm the observation of other investigators that the varicose state frequently progresses rapidly after injection treatment. Recently Edwards reported his studies on the effect of thrombosis on venous valves. He demonstrated that recannulization of the thrombosed vein frequently occurs but that the valves are permanently disabled by adhesion or actual absorption, and the recannulized vein is always incompetent. This is significant because if recannulization does occur following treatment, we are dealing with a vein whose valves have been permanently disabled by our efforts, and rapid progression of the condition may be expected.

Following high saphenous ligation we find that standing pressures are identical with those before ligation although we have apparently severed our fluid column and should, therefore, observe a decided pressure drop. It was this observation that indirectly led de Takats to conclude that ligation did not produce the desired effect and has led to its abandonment by some. If, however, we keep in mind that friction is only a factor in moving liquids and that reducing the size of a lumen does not alter transmission of pressure, it becomes reasonable to believe that the effective column of blood remains the same, the pressure being transmitted through the communicating system of veins connecting the saphenous with the deep femoral vein, and, therefore, we could not reasonably expect any diminution in pressure. However, the significant alteration in pressure following ligation occurs when the patient strains. Now we find that the pressure rises only slightly above the standing figure and then shows no further increase regardless of the intensity of the strain. So we observe in Case 1 that after ligation the standing pressure was 114 millimeters as compared with 224 millimeters prior to ligation. The femoral vein in this patient did not transmit the increased intra abdominal pressure to the saphenous vein through its communicating system because of competent valves, a fact which could be demonstrated before ligation (simple Trendelenburg positive). In view of the foregoing it is our belief that the squeezing out process which occurs during strain ade

quately accounts for the small rise noted. It is also probable that muscular action collapses the femoral vein so that intra abdominal increases in pressure are not transmitted through it. This interpretation is borne out by the majority of cases examined. We have not observed any cases of varicosities involving the short saphenous vein in which a definite communication with the long saphenous was not present, and we are of the opinion that this rather than the deep femoral vein is the usual mode of transmission of pressure to the short saphenous system.

Case 4 offers a well defined exception. Here it was noted before ligation that a large tortuous vein penetrated the deep fascia at about the lower end of Hunter's canal where a definite opening in the fascia could be palpated. Backflow filling through the deep femoral was easily demonstrated at this point. High ligation was performed as usual, but the straining pressure dropped only 2 millimeters (Table I). Following exposure and ligation of this communicating vein a further drop to 92 millimeters occurred. We have observed several cases of this type. They do not, in our experience form a very large percentage of the total. Apparently this communicating vein transmits pressure in some cases and not in others. We believe that this may be explained. Not infrequently the course of the deep femoral vein is quite superficial in the thigh due to variations in its muscular covering until it dips down through the adductor canal where its course becomes much deeper and more subject to the compressing effect of muscular action. When an incompetent communicating vein is present it is usually just above this point. The burden of proof that communicating veins below this point transmit increases in intra abdominal pressure lies with those who would sponsor this theory. We have seen no proof in the literature and nothing to substantiate this idea in our experience. Cases in which previous deep thrombophlebitis has disabled the valves of the deep femoral vein are the only exceptions.

THE VALUE OF SAPHEOUS LIGATION

The following hypothesis seems logical. With a patient standing so that the saphenous

system is distended with blood any increase in pressure exerted on any portion of this system is transmitted equally throughout the system. This is modified by the presence of an overflow sump which is the right side of the heart, and so the standing pressure is the gravity effect of the column of blood above it. The head of blood peculiar to man because of his erect posture is a most important factor in the causation of varicose veins. It is this factor that is responsible for the rapid development of varicosities in arteriovenous fistula of the leg in man, a situation which cannot be reproduced in four footed animals because the overflow sump is practically on the same level as the fistula. Increased intra abdominal pressure interrupts by compression the column of blood in its intra abdominal course, and our sump is disconnected. We are then dealing with a closed system which obeys Pascal's law. Pressure and not the reversal of flow is the dilating factor. Reversal of flow does however, permit constant filling of an elastic system so that the full effects of intra abdominal increases in pressure may be transmitted according to Pascal's law. Man, again because of co-ordinated muscular action peculiar to him because of his erect posture, is subject to unusual increases in intra abdominal pressures. The deep femoral vein is not usually involved because of the protecting mechanism of muscle and fascia.

The earlier appearance of varicose veins in the lower leg seems logically explained by the additional gravity effect toward the foot coupled with the fact that the supporting tissue is less adequate than in the thigh. It must be remembered that the decrease in the caliber of the vein does not interfere with the transmission of pressure but only the volume of flow.

High saphenous ligation would seem indicated in all cases of varicose veins where the upper saphenous shows any dilatation or transmits the impulse of coughing or other increases in intra abdominal pressure as detected by simple palpation, the usual contraindications to ligation to be observed of course. It should definitely help to prevent progression of the condition in a patient who has already shown evidence of vulnerability.

Cramping and fatigability so often complained of is frequently relieved by ligation alone. It is not a panacea sufficient of itself but is a very important part of our armamentarium, and the simplicity of the procedure permits its more general application. Injection without ligation where reverse flow is present is definitely contra indicated by experience and further substantiated by Edwards' recent studies on the effects of thrombosis on venous valves. The technique of high saphenous ligation has been well detailed by numerous authors and will not be repeated here. Retrograde injection, although not utilized in the cases described in this article because of its obvious interference with pressure readings after ligation, is used in this clinic almost routinely at the time of ligation. The detailed treatment of complications, merits of various sclerosing agents, and other factors is not properly within the scope of this paper. Much of it yet remains to be unravelled. Milk leg even of minor degree, the irreversible tissue changes of lymphatic block resulting from long standing stasis or inflammation, are problems which still largely defeat us. It would seem, however, that enough is known of the simple uncomplicated type of varicose veins regard less of degree to standardize their treatment more logically. We have sectioned saphenous veins as late as 2 years after ligation and sclerosis and found no demonstrable venous channels present. We have sectioned saphenous veins as soon as 6 weeks after apparently satisfactory chemical sclerosis and found large recannulized venous channels. At present the evidence appears to support the contention of those who favor saphenous ligation.

CONCLUSIONS

1 The erect posture has resulted in venous pressure in the legs which may reach 100 millimeters of mercury, depending on height of the patient, a fact borne out by direct readings of venous pressure. This is a pure gravity effect.

2 The erect posture has developed activity stresses which markedly increase intra-abdominal pressure and indirectly raise the saphenous pressure to unusual heights not fully evaluated previously. This, combined with a vulnerability in certain individuals, probably is sufficient to produce varicose veins.

3 Venous pressures taken before and after ligation suggest that the pressure factor outside of pure gravity effect can be relieved largely by proper saphenous ligation.

4 Recannulization in incompetent veins may be expected unless preliminary ligation has been carried out. It is unlikely to occur if ligation has obviated the increased pressure effect of strain and the reverse flow in the saphenous vein.

5 We do not believe that varicosities of the lesser saphenous occur except as a result of pressures transmitted through communications with the large saphenous.

6 Modification of present methods of testing will reveal incompetence of valves that are competent to simple gravity effects, but not to increased pressures developed under strain. Such a test is described. No previous reference to its use has been noted.

BIBLIOGRAPHY

- 1 DELBET PIERRE Pathology and prophylaxis of varicose veins. *Internat Clin* 1902 pp 50-56
- 2 DE TAKATS G, QUINN H, TELLOTON B I and GRITTENDEN P J Impairment of the circulation in the varicose extremity. *Arch Surg* 1929 18: 672
- 3 EDWARDS EDWARD ALLEN Observations on phlebitis. *Am Heart J* 1937 14 428-441
- 4 HOLMAN EMILE Arteriovenous Aneurysm. New York: Macmillan Co. 1937
- 5 MCPHEETERS H O, MERKERT C E and LUNDBLAD ROY A Mechanics of the reverse flow of blood in varicose veins as proved by blood pressure readings. *Surg Gynec & Obst* 1932 55 98-302
- 6 MURPHY DOUGLAS P and MENCERT WILLIAM F Intra abdominal pressures created by voluntary muscular effort. *Surg Gynec & Obst* 1934 58 150-154
- 7 TRENDLENBURG F Ueber die Unterbindung der Vena Saphena Magna bei Unterschenkelvaricen. *Beitr z klin Chir* 1891 7 195

A STUDY OF PATHOLOGICALLY VERIFIED EPIDERMOID CARCINOMA OF THE SKIN

SHIELDS WARREN M D, and STANLEY O HOERR M D,
Boston, Massachusetts

CARCINOMA of the skin is not infrequently regarded as a relatively benign lesion offering no particular diagnostic or therapeutic difficulties, and attended by an insignificant mortality. Study and follow up of biopsy cases clearly bring out the danger of this assumption. It is true that epidermoid carcinoma¹, basal cell carcinoma and malignant melanoma each present typical individual characteristics. Yet even the most experienced observer may err in the differentiation of various types of malignancy or even in distinguishing between malignant and non malignant lesions. The practice of treating small lesions and some times even large ones without microscopic verification of a clinical diagnosis leads inevitably to diagnostic errors. Thus a 'typical epidermoid carcinoma' may later prove to be a malignant melanoma or a 'pigmented papiloma' turn out to be a basal cell carcinoma. Conversely it is hardly to be doubted that cures have been recorded for supposed malignancies which were actually benign. Appropriate therapy is dependent on accuracy of diagnosis in tumors of the skin consistently accurate diagnoses are not possible without microscopic control. A lack of appreciation of this fact has contributed to unwarranted optimism in regard to cutaneous cancer. Biopsy followed by immediate therapy does not impair the prognosis nor even with a delay of several days in preparing sections of minute biopsies unsuitable for frozen section does the hypothetical increased danger of spread outweigh the gain in information.

It is the purpose of this paper to evaluate factors influencing one type of cutaneous malignancy epidermoid carcinoma. It will be

shown that it still offers a serious therapeutic problem, and that any lesion of this type is an active threat to life.

MATERIAL USED FOR STUDY

This study is based on a consecutive series of 507 pathologically verified epidermoid carcinomas of the skin seen at the Collis P Huntington Memorial Hospital between its opening in 1912 and January 1, 1937. The series represents lesions on 486 persons, since 19 individuals had 2 or 3 tumors each making a total of 40 duplications. All regions of the skin have been included except lip vulva penis and anus, where the mucocutaneous junctions and the frequency of mucosal cancers make it impossible to be sure of the point of origin of the tumor. Sections of all tumors diagnosed as epidermoid carcinoma of the skin in the hospital laboratory files were reviewed and regraded. Doubtful cases as well as those unsuited for histological grading (i.e., either too small or too poorly prepared) were excluded. The lesions were placed in one of three grades by the method in use in this laboratory a modification of Broders classification based on differentiation of the tumor cells, frequency of mitosis, and extent of infiltration. The 507 carcinomas showed the following grade distribution: 38%, 75 per cent low malignancy, grade I; 11.4, 22 per cent medium malignancy, grade II; 11.3 per cent high malignancy, grade III. For the purpose of this study the tumors of medium and high malignancy are grouped together as grade II plus III and contrasted with the grade I lesions of low malignancy.

A follow up of a year or longer, or a definite knowledge of the cause of death is available on all but 43 of the 507 lesions. The data were based on hospital visits as given in the record, questionnaires, and death certificates.

From the Laboratory of Pathology Collis P Huntington Memorial Hospital

¹Also known as squamous cell perle cell or keratinizing carcinoma or acanthoma

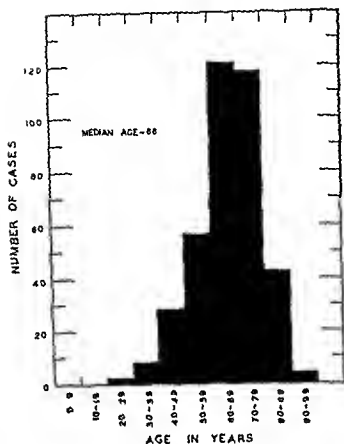


Fig 1 a Grade I Age distribution by grade

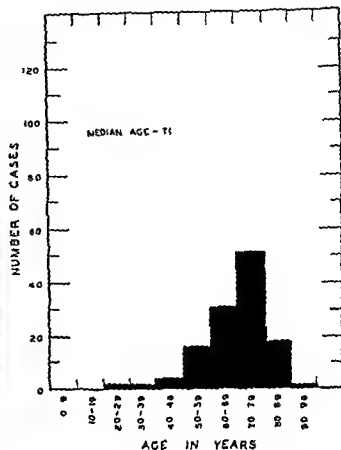


Fig 1 b Grade II plus III Age distribution by grade

We have based consideration of prognosis on those 401 cases seen and treated prior to January 1, 1933, permitting a 5 year follow up. In this group the end results were 158 5 year cures, 101 deaths from intercurrent disease before 5 years elapsed, 83 deaths from cutaneous cancer, 59, 15 per cent, lost (followed for less than 5 years). The case histories have been conservatively interpreted, the most pessimistic viewpoint possible concerning the result of any given lesion has been adopted, so that when a study of the available data indicated a possibility of persistence, recurrence or metastasis, this possibility has been taken as fact.

In cases of death the data were ambiguous in 6 instances. In each of these death was from cancer, but there was a possibility that another lesion—epidermoid or otherwise—might be responsible. These 6 cases have been included with the other deaths from cutaneous cancer.

One hundred and forty five, 30 per cent, of the 486 persons represented in the series had

malignancies elsewhere in the body, about 70 per cent of these were confined to the skin (Table I). Forty-six, 9 per cent, of the patients gave a history of carcinoma in some other member of the family.

AGE, SEX, AND OCCUPATION

The ages at the time of first treatment are given in Figure 1. There is no significant difference in the two histological groups. The

TABLE I¹—MULTIPLE MALIGNANT TUMORS GROUPED BY LOCATION SKIN OR ELSEWHERE

	Total persons	All multiples		Multiple in skin only		Multiple in skin and cancer elsewhere		Not multiple in skin but cancer elsewhere	
		No	Per cent	No	Per cent	No	Per cent	No	Per cent
Grade I	366	115	32	70	22	0	2	27	7
Grade II plus III	123	33	27	24	19	3	2	6	5
All grades	486	148*	30	100	21	12	2	33	7

*Discrepancies in totals from three cross-duplications between grades I and II plus III.

¹All cases corrected for duplication. 16 included with skin in this table.

TABLE II—FACTORS AFFECTING SIZE
Grade I

Sex	Anatomical site	Duration—when known				Previous treatment		Vitality	
		Less than 1 year	1 to 3 years	3 to 5 years	5 years or over	All types	Radiation only	Alive	Completed
Male		64	33	7	7	85	8	110	22
Female		63	37	15	27	38	3	15	2
Both		60	40	9	34	7		55	24
Site		3	0	7	25		13	25	5
Total		124	69	21	61	94	55	135	49
Apparent median		2	2	2	3	2	3	6	2

Grade II plus III

Male	5	5	4	7	4	3	3	17	4
Female	37	5	15	5	1	6	8	51	6
Both	33	9	1	4	5	15	8	20	4
Site	13	2	7	3	5	1	0	24	4
Total	13	31	43	13	27	46	18	105	8
Apparent median		2	2	2	2	2	1	2	2

youngest patients in the series were two 20 year old males one with a grade I lesion of the ear the other with a grade II lesion of the arm. The oldest patient was a 94 year old male with a grade I lesion of the ear. The age span for females ranged from 29 to 90 years. More than 75 per cent of the lesions in this series occurred on persons over 60 years of age. A cross analysis of age distribution by grade, size of lesion and location does not yield any striking relationships. Nose and eyelid however have a larger proportion of younger persons than any other locations roughly a third of the cancers of the nose and a half of those of the eyelid occurred in patients below 60 years. The age distribution and the median age showed no significant sex difference for grade I lesions the approximate median age was 68 and for grade II plus III, 71 years.

Three hundred and sixty nine 73 per cent of the lesions were on males 138 27 per cent on females and this ratio of approximately 3 to 1 holds for both grades I and II plus III considered separately.

Occupational data were available on 304 males with head and hand lesions and on 94 females. One hundred and sixty five, 54 per cent of the males had "outdoor" occupations

(farmer, laborer, carpenter, teamster etc) an additional 9 with hand lesions had an occupation in which chemical or mechanical irritation might be a factor (welder, roofer, photographer, dye maker etc). On the contrary none of the females had definite outdoor occupations, and only one, a laundress had a possible irritative etiology for her hand lesion on an occupational basis. Outdoor occupation may be a partial explanation of the higher incidence in males.

SIZE

Lesions have been grouped by size based on their greatest diameter when first seen in the Huntington Hospital.

Table II gives the size distribution by grade. The longer the stated duration of the lesion the larger the median size. The more malignant lesions are larger on the average the median size for grade I being $1.7 \pm$ centimeters, and that for grade II plus III $2.2 \pm$ centimeters. This may be partly explained by the more rapid growth of the more malignant lesions, although the longer average duration of grade II plus III lesions must also be considered. In either event, the greater average size of the grade II plus III lesions is a con-

tributing factor to the higher mortality of this group

Lesions which had received previous treatment before coming to the hospital averaged larger than untreated ones, but a part of this may be attributed to their greater average duration

The visibility of the lesion correlates like wise with size, sites concealed by clothing when grouped together, contributed a disproportionate number of the larger lesions

The largest lesions in the series were on the scalp. One grade I carcinoma 30 centimeters in greatest diameter had never healed following earlier excision, and ultimately proved fatal. A 20 centimeter grade I carcinoma of scalp was excised in July of 1926, and patient was alive and well without disease in April of 1938

No significant relationship exists between the size of the tumor and the age of the patient

LOCATION AND GRADE

The sites of predilection are the exposed portions of the body—the head, hands, and fingers—which account for 457, 90 per cent, of all the lesions. Table III gives the relative frequency in the various sites analyzed by grade and sex. The ears 26 per cent, lead in frequency all locations as we have subdivided them. Hand and fingers together account for about 20 per cent. All of these cases occurred on the dorsum, none on the palm.

The ratio of low to high malignancy is approximately 3 to 1 in the various sites, the most notable exceptions being the eyelid, nose, scalp, trunk, and mastoid region, where grade II plus III lesions are proportionately less frequent. This is counterbalanced by lesions of the forehead, temple, cheek, and malar region, where grade II plus III carcinomas are relatively more numerous.

In several sites the lesions show a predilection for one sex. On the ears, mastoid region, and neck, more than 90 per cent of the lesions are on males. Females have more lesions than males on scalp, eyelid, and trunk. Lesions of temple, forehead, leg, and thigh are divided about equally between males and females. The sex ratio in any one location is roughly the same for grades I and II plus III.

TABLE III—RELATIVE FREQUENCY OF GRADES IN VARIOUS SITES BY SEX

Location		Grade I		Grade II plus III		Total by Sex	Totals	Sites per cent
		No	Per cent	No	Per cent			
Scalp	M F	1 6	5 100	1 —	50 —	2 6	8	16
Forehead	M F	8 7	61 64	5 4	39 36	13 11	24	47
Temple	M F	3 9	61 75	5 3	39 25	13 12	25	49
Malar region	M F	9 —	75 —	3 —	25 —	12 —	17	33
Eyelid	M F	8 12	89 100	1 —	11 —	9 13	21	41
Cheek	M F	16 14	75 64	15 8	89 30	31 38	73	144
Nose	M F	22 14	81 87	5 2	19 10	26 26	42	83
Chin	M F	3 1	75 50	1 1	25 50	4 1	6	12
Ear	M F	91 7	77 70	23 3	75 50	114 10	124	237
Mastoid region	M F	10 —	92 —	1 —	9 —	11 —	11	22
Neck	M F	9 1	60 50	6 1	40 50	15 1	17	33
Trunk	M F	4 5	100 71	— 2	— 20	4 7	11	22
Finger	M F	8 6	100 67	— 3	— 33	8 9	17	33
Hand	M F	33 14	80 81	13 3	29 15	66 17	83	164
Arm	M F	1 2	53 100	— —	67 —	3 2	5	10
Foot	M F	3 —	100 —	— —	— —	3 —	3	6
Leg and thigh	M F	4 2	80 40	1 3	20 60	5 5	10	20
Scrotum	M F	3 —	75 —	1 —	25 —	4 —	4	8
Totals	M F	281 201	76 73	88 37	24 17	369 135	507	1000
		352	75	125	25	507		

RECURRENCE

A lesion was considered to be recurrent only if complete healing was noted to have taken place after the original treatment. There were 32 recurrences in grade I lesions and 9 in grade II plus III. Twenty five recurrent grade I lesions and 8 of the higher malignancy group had sufficiently detailed data to warrant further analysis, approximately 7 per cent and 6 per cent, respectively (Table IV). Of these, 14 of the grade I and 6 of the grade II plus III

TABLE II—EFFECT OF SIZE AND GRADE OF PRIMARY LESION UPON RECURRENCE METASTASIS AND PROGNOSIS

Size in cm	All cases						Cases prior to January 1, 1931					
	Number of cases I plus II plus III	Recurrence—per cent I plus III	Metastasis—per cent I plus III	Number of cases I plus II plus III	Recurrence—per cent I plus III	Metastasis—per cent I plus III	Number of cases I plus II plus III	Recurrence—per cent I plus III	Metastasis—per cent I plus III	Number of cases I plus II plus III	Recurrence—per cent I plus III	Metastasis—per cent I plus III
2 or less	111	15	5	15	5	0	45	23	50	34	8	0
2.1 to 5	117	57	7	0	5	14	105	47	47	0	20	2
6 to 5	60	35	18	3	15	24	53	5	20	12	43	26
5 to 10	36	18	11	0	22	44	0	15	20	0	23	00
Doubtful size	13	0	(Figured into the totals)				26	0	(Figured into the totals)			
All sizes	337	35	7	6	0	21	304	27	44	24	7	21

recurrences were pathologically verified. Increased anaplasia appeared only in 3 grade I lesions. In 2 instances a report on the original lesion is not available and so the recurrences as grade II or grade III might actually represent an increase in grade. Thirty eight per cent of the grade II plus III lesions had received previous treatment whereas only 26 per cent of grade I lesions were previously treated. This difference may be interpreted in one of two ways either that the treated grade II plus III lesions were all originally

grade II or grade III at the time when they first received treatment, and were correspondingly difficult to eradicate, or that some of them were originally grade I and recurred as grade II or grade III by the time they arrived at the Huntington Hospital.

Grade II plus III recurrences all took place within 1½ years from the time of healing after the original treatment, however 4 grade I lesions recurred after a 3 year latent period. One of these grade I recurrences (proved by biopsy) appeared more than 6 years after the original treatment and another (definite clinically but not proved pathologically) appeared more than 7 years after complete healing following treatment (Table V).

Subanalyses of factors affecting recurrence must be interpreted very cautiously because of the small total number of recurrences comprising the series. However the recurrence rate in grade I was higher in the larger lesions—11 per cent for those larger than 2.5 centimeters, 5 per cent for those 2.5 centimeters or less. Not even tentative conclusions are permissible in the 8 grade II plus III cases.

In correlating frequency of recurrence with treatment of the original lesions at the Huntington Hospital it was found that there were more recurrences following radium therapy than surgical excision—11 per cent as opposed to 6 per cent in grade I cancers and 10 per cent as against 5 per cent in grade II plus III cancers. Light of the 58 tumors—14 per cent in grade I having previous radiation developed recurrences and 5 of 29 tumors—17 per cent, of grade II plus III which are slight increases over the average for the grade. There are not

TABLE V—TIME OF APPEARANCE OF RECURRENCES AND LATER REGIONAL METASTASES DATED FROM ORIGINAL TREATMENT

(Type recurrence with time dated case) Recurrence cases Metastases

Elapsed time—Grade I—

6 months	0	0
1 year	5	7
1½ years	1	0
2 years	2	2
2½ years	1	1
3 years	0	1
3½ years	1	0
4 years	0	0
4½ years	1	0
5 years	0	1
5½ years	0	0
6 years	0	0
6½ years	1	0
7 years	0	0
7½ years	0	0
8 years	1	0
Total	25	21

Elapsed time—Grade II plus III—

6 months	1	8
1 year	3	2
1½ years	4	1
2 years	0	0
Total	8	11

TABLE VI—COMPARISON¹ OF RADIUM AND EXCISION INITIAL HEALING AND PROGNOSIS
Grade I

Size in cm	Number of cases		Initial healing—%		5 year cure—%		Mortality rate—%	
	Excision	Radium	Excision	Radium	Excision	Radium	Excision	Radium
1 or less	87	11	99	83	61	45	4	38
1 1 to 2 5	84	13	99	83	55	8	13	67
2 6 to 5	37	15	86	27	41	0	55	67
5 1 or more	12	11	70	50	25	0	55	89
Doubtful size	13	3	—	—	—	—	—	—
All sizes	212	53	95	50	54	11	16	62

Grade II plus III

Size in cm	Number of cases		Initial healing—%		5 year cure—%		Mortality rate—%	
	Excision	Radium	Excision	Radium	Excision	Radium	Excision	Radium
1 or less	13	0	100	No cases	54	No cases	0	No cases
1 1 to 2 5	32	6	99	67	51	57	8	75
2 6 to 5	17	7	50	55	6	29	50	67
5 1 or more	8	6	50	0	0	0	100	100
Doubtful size	2	0	—	—	—	—	—	—
All sizes	72	19	82	33	26	16	35	81

¹Cases prior to January 1, 1933

enough lesions treated by roentgen ray for valid comparison. Analysis by location shows nose, temple, trunk, and leg having recurrence rates more than double the group average for the combined grades.

Ulceration of the initial lesion was the almost universal rule—24 of 25 grade I and 6 of grade II plus III. Repeated recurrences took place in about half of the cases. If metastases were present at the time of treatment, local recurrences followed in 5 of 21 cases, 24 per cent, for the entire group.

Age does not appear to be a factor.

END RESULTS

Recent therapeutic advances cannot be appraised, since only cases in which lesions were treated prior to January 1, 1933, are used in studying end results. Prior to 1933 the chief modes of treatment in this series were radium (used as radon) and some form of excision (either with scalpel or cautery knife). In the 25 year period covered by this report, the technique of radium therapy has varied as well as indications for its use. The usual procedure throughout has been the surface application of nearly unfiltered radon. This often resulted in superficial regression of the tumor with continued growth in its deeper portion. Prior to 1920 the dosages were

entirely inadequate in the light of present standards. At present this form of treatment is used only for superficial lesions. The diminishing use of radium in sizable tumors is shown by the following figures: 40 per cent of our verified cases were treated with radium between 1912 and 1922, 12 per cent in 1923 through 1927, and 8 per cent in the years 1928 through 1932. When radiation is deemed advisable for deeper tumors, roentgen ray therapy, because of more uniform distribution of the rays, is now employed. No general statement as to dosage over this period of years (1912-1933) can be made because of shifting standards of treatment, and the occasional use of supplementary interstitial radiation with glass or gold radon seeds. Unfortunately the extensive employment of roentgen radiation has been a recent development and there were not a sufficient number of biopsied cases to permit inclusion in this study.

The series obviously includes all lesions excised, and only a small portion of those treated by radium since many radium treated lesions were never subjected to biopsy. Comparison between the two is permissible, however, after correcting for size and grade. The results are shown in Table VI where excision is seen to give a higher percentage of initial healing as well as a better prognosis in both histological

TABLE VII—VARIOUS FACTORS AFFECTING PROGNOSIS ANALYZED BY SIZE AND GRADE
Grade I

Size	A—Mortality rate (per cent)								B—5 year cure (per cent)							
	Primary group	Primary dissection	All positive treatment	Reoperation	Metastases	Primary per cent of all patients	Excising ear and hand lesions		Primary group	Primary radiation	All post treatment	Reoperation	Metastases	Five year per cent of all patients	Excising ear and hand	
							Excision	Radium							Excision	Radium
Total cases (cm.)	14	5	8	10	34	272	104	44	304	50	8		34	7	94	44
1 cm. less—	8	50	0	25	100	3	6	35	50	70	54	25		61	66	45
1.5 cm.—	10	40	31	100	83	6	25	67	40	45	52	0	0	33	30	11
2 to 3 cm.—	43	71	57	50	00	36	50	67	0	0		0		35	3	
5 cm. more—	73	00	00	100	25	60	57	83	0	0	0	0	0	3	30	
All cases—	7	46	48	63	85	6	24	50	44	25	34	5	3	40	45	14

Grade II plus III

Total cases (cm.)	97	4	36	6	26	75	42	15	97	24	36	6	6	75	41	15
1 cm. less—	0		0	0	—	0	0	—	34	100	100	00	—	54	53	—
1.5 cm.—			0	50	83	7		67	20	10	36	0	12	3	41	
2 to 3 cm.—	76	00	00	00	100	36	83	60		0	0		0	15	0	33
5 cm. more—	100	100	00	—	86	100	75	00	0	0	—	3		4	0	
All cases—	5	67	69	40	86	34	31	75	4		10	33	1	25	13	

(As per Table I, 1933)
All cases with metastases up to 1933 are included in the table. Mortality rates of 100% are given for groups with both resection and 5 year survival rates. See Table I for mortality.

groups and for practically all sized lesions (In passing it might be pointed out that the table illustrates the wide discrepancy between percentage of initial healing and true end results when the latter are calculated conservatively. We feel that initial healing used by itself as an indication of the results of treatment is misleading and of less significance than is frequently attached to it.) Since nearly all ear and hand cases have been treated by excision and since it might be argued that these locations carry a lower mortality and thus balance the scales in favor of excision a comparison is made in Table VII, excluding these sites, this again shows better results following excision. An additional fact not brought out in the table is that 10 radium failures in both histological groups were converted to 5 year cures by excision whereas only 1 excision failure was thus successfully treated by radium.

One hundred and forty five of the individual lesions received some kind of treatment before

coming to the Huntington Hospital, and 87 of these had had some form of radiation therapy. This does not include the numerous patients who treated their lesions with salves ointments and other simple measures of no therapeutic significance. Table VII shows the adverse effect of previous therapy on prognosis.

Table VIII demonstrates that, although the prognosis for the entire group treated 19 8-1932 is better than that of the two earlier periods, this is in large part a result of the greater proportion of small lesions being treated. The approximate median size of grade I lesions in the 1912-1922 group was 2.3 centimeters in the 19 8-1932 group it was 1.3 centimeters. For grade II plus III lesions the difference is less pronounced, it was 2.4 centimeters in 1912-1922 and 2.2 centimeters in 1928-1932. Under these circumstances, the prognosis would improve for the later group regardless of improvement in therapy. Figure 2 gives the mortality rates by grades and size for these periods.

TABLE VIII—PROGNOSIS ANALYZED BY TIME PERIODS I 1912 through 1922 II, 1923 through 1927 III, 1928 through 1933

Grade I

Size in cm	1912-1922			1923-1927			1928-1933		
	Total	5 year cure—per cent	Mortality—per cent	Total	5 year cure—per cent	Mortality—per cent	Total	5 year cure—per cent	Mortality—per cent
1 or less	14	50	0	25	62	22	58	60	8
1.1 to 2.5	39	43	22	27	52	23	47	47	10
2.6 to 5	21	19	67	29	32	55	28	30	27
5.1 or more	22	0	100	9	53	50	8	0	50
Doubtful	8	—	—	5	—	—	3	—	—
All sizes	84	35	44	86	43	25	134	43	16
Median size	2.3 cm			2.9 cm			2.3 cm		

Grade II plus III

Size in cm	1912-1922			1923-1927			1928-1933		
	Total	5 year cure—per cent	Mortality—per cent	Total	5 year cure—per cent	Mortality—per cent	Total	5 year cure—per cent	Mortality—per cent
1 or less	2	50	0	2	50	0	9	56	0
1.1 to 2.5	12	25	43	9	22	23	21	38	9
2.6 to 5	6	0	100	4	25	50	15	53	70
5.1 or more	6	0	100	2	0	100	7	0	100
Doubtful	1	—	—	0	—	—	1	—	—
All sizes	27	25	70	17	28	38	53	59	43
Median size	2.4 cm			2.2 cm			2 cm		

There were 38 grade I metastases and 28 grade II plus III. In interpreting end results, 34 grade I metastases, 9 per cent, and 26 grade II plus III, 20 per cent were further analyzed. Twenty five of this group of 60 were pathologically proved. The metastases were to the regional nodes in all cases except one in which regional nodes were not mentioned while "liver and lung" metastases were reported on a death certificate. In 2 of 8

cases in which patients died of the cutaneous cancer and in which postmortum material is available to us, there were also distant metastases. One, a primary tumor of the scrotum, had metastases to the para aortic nodes, the second, a primary tumor of the lower leg, had liver metastases. In addition, 3 death certificates mentioned distant metastases. One, a carcinoma of the ear, was reported to have "liver and lung metastases", the second, a

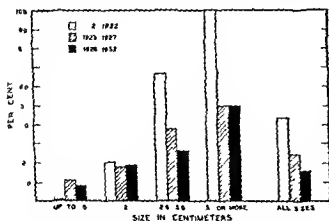


Fig 2 a Grade I Mortality rate by time intervals by size and by grade of primary lesion

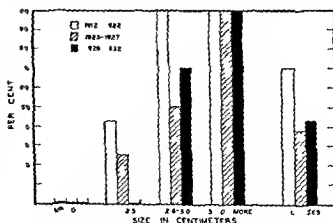


Fig 2 b Grade II plus III Mortality rate by time intervals by size, and by grade of primary lesion

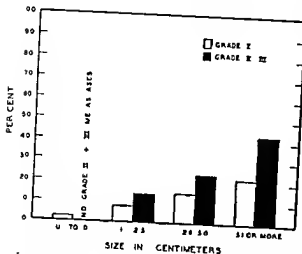


Fig. 3 Rate of metastasis by size and grade of primary lesion

carcinoma of the cheek, mediastinal involvement, the third a carcinoma of the ear metastasizes to the brain. Since in none of these 3 instances is the method of establishing the diagnosis known they may be taken merely as interesting observations. One may conclude that distant metastases are rare.

Thirteen of the grade I lesions showed regional metastases when the patient was first seen; 21 developed them subsequently. In the higher malignancy group 14 showed metastases on admission and 11 developed them subsequently. The time when the metastasis made its appearance is indicated in Table V. Metastases from grade II plus III lesions took place in less than 1½ years from the original treatment whereas those from grade I occurred up to 5 years afterward.

A definite relationship between the size of the lesion when first treated and its power to metastasize is demonstrated in Figure 3 showing a jump in rate from less than 5 per cent for all lesions 1 centimeter or smaller to 22 per cent in grade I and 44 per cent in grade II plus III lesions larger than 5 centimeters. The figure also shows the increased power to metastasize in the higher grades size for size.

Approximately 18 per cent of the previously treated lesions in grade I and 32 per cent of grade II plus III metastasized—substantial increases over the group averages. Previous radiation therapy did not further increase this tendency. However, the grade II plus

TABLE IX—DURATION TO DEATH IN FATAL CASES FROM TIME OF FIRST TREATMENT (Death within time indicated)

Time elapsed—	Grade I	Grade II plus III
6 months	0	1
1 year	16	13
1½ years	12	7
2 years	5	7
2½ years	3	2
3 years	0	0
4 years	4	1
5 years	3	0
6 years	2	0
7 years	3	0
8 years	0	0
9 years	1	0
Total	58	31

Includes three postoperative deaths and one post x ray death

III cancers which had been treated previously did not metastasize more frequently than would be expected from the greater size of the lesions, the treated grade I lesions on the other hand when corrected for size metastasized more than half again as frequently as the untreated group.

A study of the type of treatment given the original lesion showed 5 per cent—15 of 288—of all grade I lesions treated by excision developing metastases subsequently and 7 per cent—4 of 54—of those treated with radium. In grade II plus III the figures were excision, 11 per cent and radium, 16 per cent.

Age distribution of the metastases differs in the two groups. In the lower malignancy group there is a higher rate of metastasis in the younger patients; in the higher grades metastases seem to be independent of age. These findings are borne out by a further analysis correcting for size. Location of the original lesion does not seem to play an important rôle except that tumors of the nose and eyelid rarely metastasize.

Ninety-five deaths were directly attributable to epidermoid carcinomas of the skin. This gives a mortality of nearly 19 per cent. An additional 18 were not cured at the time of the last follow up or at the time of the patient's death from other causes. Of the deaths, 62 occurred in grade I lesions, a 16 per cent mortality, and 33 in grade II plus III lesions, a 26 per cent mortality.

One of the reasons why cutaneous carcinoma sometimes fails to receive the attention it deserves is that it is so slow in killing, even when it does prove fatal. Table IX shows the time elapsing between first visit and death in the 89 cases treated at the Huntington Hospital. The deaths within 6 months include 4 dying as a result of treatment, 3 postoperative fatalities, and 1 death from erysipelas following an x-ray treatment to a carcinoma of the ear. The table not only shows the protracted course but also indicates that degree of malignancy has some bearing on the life expectancy in fatal cases.

In analyzing the deaths, one notes how unfavorable most of the fatal lesions already were when first treated. Of the 95 deaths, 6 received no treatment at all or treatment elsewhere. Twenty one of the remaining 89 already showed metastases when first seen, and 23 that did not metastasize were larger than 5 centimeters. Thus, at least 50 of the fatal cases offered little hope of cure when first seen.

PROGNOSIS

It is especially difficult to investigate factors affecting prognosis in a group of elderly persons who have a limited life expectancy. We have applied here the "5 year cure" principle which is an accepted standard in all fields of cancer investigation, but it must be realized that the age incidence in our series is considerably older than that in any other form of cancer, and that 25 per cent die of intercurrent disease unrelated to the skin lesion within a 5 year period. Since we have adopted conservative formulas for expressing the rate of cure and mortality, it must likewise be remembered that these figures are consequently rather less favorable than they would be in equivalent groups of younger persons. However, a consideration of mortality and cure together does allow certain conclusions.

The formula that we employ for per cent 5 year cure is as follows:

$$\frac{\text{Number of 5 year cures} \times 100}{\text{Total cases treated}}$$

The formula for per cent mortality is

$$\frac{\text{Number of deaths from cancer} \times 100}{\text{Number of 5 year cures + uncured cases (living and dead) + deaths from cancer}}$$

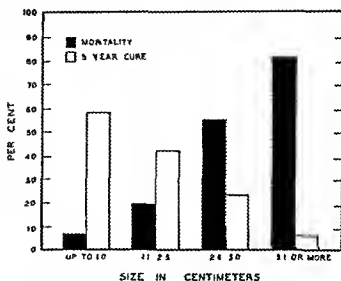


Fig. 4 Size of primary lesion and prognosis combined grades

Calculation by this method leaves a residual group not presented in the tables made up of cases followed less than 5 years, and cases dead of intercurrent disease before 5 years.

As previously explained, only patients on whom a 5 year follow-up was possible—those treated prior to January 1, 1933—have been used in the prognosis studies, these number 401—304 grade I and 97 grade II plus III.

Size. The relationship between the size of the lesion at the time of first treatment, and prognosis, is illustrated in Figure 4, where all other factors except size are disregarded. The larger the lesion, the poorer the outlook for cure and the greater the mortality.

Age. Age does not bear any certain relationship to prognosis. Table X indicates that the younger patients and the very old should be given a more guarded prognosis, for grade I tumors have a worse prognosis in the younger age group and grade II plus III tumors in the older, though there is no significant increase in the size of the lesion in these age groups.

Grade. One must consider that grade II plus III lesions average larger than grade I lesions, in comparing the prognosis of the two groups. Figure 5 and Table IV compare the mortality and 5 year cure after correcting for the size of the lesion. Grade II plus III lesions have a consistently less favorable outlook, more pronounced in the larger lesions.

Location. It might be supposed that tumors in certain locations would be more malignant

TABLE X—PROGNOSIS AND AGE

Cases prior to January 1, 1933

Lesions	All grades			Grade I			Grade II plus III		
	Total	5 year cure—percent	Mortality—percent	Total	5 year cure—percent	Mortality—percent	Total	5 year cure—percent	Mortality—percent
30 lesions	11	18	67	7	14	75	4	5	50
41 age	20	50	25	25	60	22	4	5	5
51 age	50	47	31	45	51	32	14	35	5
601 age	10	45	5	95	45	27	2	35	35
71 age	132	35	15	94	44	24	38	15	60
81 age	40	5	47	34	24	27	15	7	75
All age	400	39	3	333	44	27	97	24	5
12 total				1					

TABLE XI—LOCATION AND PROGNOSIS

Cases prior to January 1, 1933

		Face group	Ear	Cheek and malar region	Forehead and temple	Nose	Eyelid	Malar region and cheek	Hand and finger	Cosmetic from D	Necrosis group
Total cases		42	114	74	43	33	7	18	69	71	110
Mortality rate—	Grade I	27	24	45	31	40	11	12	38	4	
	Grade II plus III	51	64	59	60	5	—	70	31	33	5
5 year cure—	Grade I	44	57	75	15	75	55	54	55	33	55
	Grade II plus III	3	0	1	2	4	—	8			5
Excluded: hand and foot											

than others. Table XI shows nose and face lesions to have a high mortality, while hand and finger, mastoid region and neck carry a low mortality. Although it is found that the more favorable sites have slightly smaller lesions, correcting for size fails to explain the difference.

One may divide locations into those in which cosmetic considerations play a role: cheek, forehead, eyelid, temple, malar region, nose and chin—and those in which cosmetic considerations are not of especial interest: ear, scalp, trunk, mastoid region, neck, leg, scrotum, arm and thigh. The number of cases in the two groups is approximately the same, and the size distribution does not differ significantly. A comparison of the prognosis of these two groups when considered by grade is shown in Table XI. There is an improved prognosis with the group in which cosmetic considerations do not influence therapy.

The graver prognosis when the lesion had received previous radiation therapy has al-

ready been pointed out (Table VII). This accords well with the prognosis of recurrences, since a good many lesions receiving prior treatment were probably recurrences rather than out and out therapeutic failures at the time of their first visit here. Table VII shows that the outlook after recurrence has taken place is also graver—the 5 year cure rate in grade I is 15 per cent, the mortality rate, 62 per cent. There are too few cases for significance in grade II plus III although they show the same trend.

The treatment of metastases has been most discouraging (Table VII). Of 34 grade I metastases, there was only one 5 year cure which followed a dissection of axillary metastases from a lesion on the dorsum of the hand. There were 29 deaths and 4 uncured at the time of the last follow up. In grade II plus III metastases there were three 5 year cures in the 26 cases, all following excision of the affected nodes. Two of the primary lesions were of the leg with groin metastases and 1

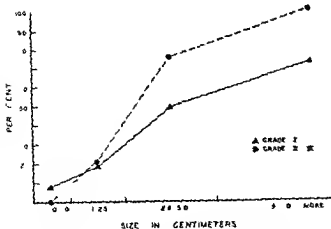


Fig 5 a Mortality rate Grade and prognosis corrected for size

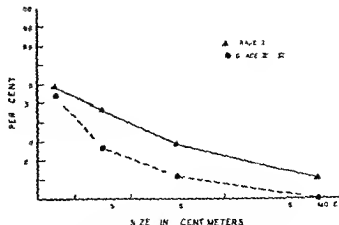


Fig 5 b Percentage of 5 year cures Grade and prognosis corrected for size

was of the ear with cervical metastases. There were 19 deaths, and 4 patients were followed for less than 5 years.

Since it has been shown that the increased power to metastasize is one of the characteristics of the more malignant lesions, and since it can be seen that metastases markedly increase the mortality, the question naturally arises as to whether the increased mortality rate in grade II plus III is a result solely of the metastases. However, when all metastasizing lesions have been excluded, the grade II plus III lesions still carry the graver prognosis (Table VII) in sizes larger than 2.5 centimeters.

SUMMARY

1. Five hundred seven consecutive cases of pathologically verified and graded epidermoid carcinoma of the skin on 486 persons, seen at the Collis P. Huntington Memorial Hospital in the 25 year period ending December 31, 1936, are reviewed statistically. Three hundred and eighty-two (75 per cent), were grade I, 114 (22 per cent), were grade II, and 11 (3 per cent), were grade III.

2. Ninety-five of the lesions were known to result fatally, a mortality of 19 per cent. The size of the lesion when first treated is shown to influence prognosis more than any other factor, lesions larger than 5 centimeters carried an 82 per cent mortality as contrasted with a 7 per cent mortality for those 2 centimeter or smaller.

Histological malignancy is next in importance, grade II plus III lesions carrying a 5 to 20 per cent greater mortality than the less malignant grade I lesions for any given size larger than 1 centimeter.

3. Other factors affecting prognosis adversely are treatment prior to coming to the hospital (especially with radium or x-ray), and the presence of metastases at the time of admission. Duration of the lesion or its location in unexposed sites are of importance only in so far as they affect the size.

4. Analysis of therapeutic results indicates that radium (used only as radon and largely as surface radiation) is less satisfactory than surgical excision. In recent years radium therapy has been increasingly restricted to the more superficial lesions. Too few proved cases which were treated by the roentgen ray are represented in this series to warrant comparison.

5. Analysis of prognosis by succeeding time intervals shows an improvement in outlook in the most recent one (1928-1932 inclusive). This is explained in large part by the greater proportion of small lesions in the latest time period rather than by fundamental improvements in therapeutic technique. It suggests that the best prospect for control of cancer of the skin, as with cancer elsewhere, lies in early recognition and adequate treatment while the lesion is still small.

STUDIES ON IHL CHEMICAL STERILIZATION OF SURGICAL INSTRUMENTS

I A Bacteriological Evaluation

E. H. SPAULDING, Ph.D. Philadelphia, Pennsylvania

THE disinfection of sharp implements by immersion in a chemical solution has gradually become an established practice. According to a recent survey by Ecker and Smith, 36 per cent of the hospitals reported the use of such a procedure. A similar institutional census (1) would indicate that for the sterilization of scalpels 63 per cent use chemical solutions exclusively.

Because of the ease and convenience with which the chemical principle may be applied its wide application would unquestionably be justified if such a method does, indeed, produce complete sterility within a reasonable length of time. Contaminated surgical instruments, however, occasionally contain bacterial spores as well as the less resistant vegetative forms. Most of these spores are highly resistant to destruction by chemicals. The anthrax spore, for instance, is capable of surviving 5 per cent phenol for a period of from 2 to 40 days (24). Since all disinfectants operate by combining chemically with the protein or other constituents of the bacterial cell, the presence of any organic matter diminishes the germicidal activity. Therefore surgical instruments should constitute difficult objects for disinfection, since they are often allowed to dry while covered with blood and exudate. Is it not pertinent, then, to ask whether the chemical agents recommended for this purpose have been adequately and appropriately tested?

The literature contains only meager data regarding the practical testing of chemical solutions against contaminated instruments. Leusden and von Bremen recently compared boiling alone with boiling in solutions of disinfectant, the latter being definitely superior

Ecker and Smith and Sobernheim studied the action of hot solutions of soda, formalin and borax upon soil spores. "Cold" sterilization, however, has not been investigated in a controlled or practical manner. Most of the data upon which proprietary and non proprietary solutions are recommended consist of phenol coefficient determinations or various modifications of the Reddish germicidal test (16). The phenol coefficient is inadequate for testing undiluted surgical disinfectants. Its applicability for other purposes is being questioned constantly (8, 11, 12), but it is especially inappropriate as an index of bacterial destruction in the presence of large amounts of blood and tissue dried upon metal.

The series of experiments to be described attempts to determine the length of time required by selected chemical solutions to sterilize knife blades heavily contaminated with pure cultures of bacteria suspended in blood or exudate. No standard procedure for the testing of surgical disinfectants has been proposed. The United States Food and Drug Administration recommends the phenol coefficient method (18). Since this technique is of dubious value, the general principle described in the present article might serve as a basis for the formulation of a standard procedure (17).

Chemical solutions tested. Many agents have been proposed for the chemical sterilization of instruments. For this study 7 solutions have been selected to represent as many different types of products as possible. Ecker and Smith found that phenol (alcohol rinse) 50 to 95 per cent alcohol, and varying concentrations of lysol were most commonly employed. In addition, 3 commercial products were chosen because of their wide usage and fundamentally different compositions. The institution at

TABLE I—NON SPORULATING SPECIES
Shortest test interval (minutes) producing sterility

	Phenol alcohol	Alcohol 70 per cent	Cresol 5 per cent	Borax formalin	Metaphen	Bard Parker	Zephiran	Blade count (thousands)
<i>Staphylococcus aureus</i>								
Pus Wet		2	3	10	2	/	5	11 520
Dry	5	10	10	5	5		5	81
Blood Wet	/	2	1	10	3	/	5	4 031
Dry	/	5	1	5	3	2	5	141
<i>Pseudomonas pyocyanea</i>								
Pus Wet	/	2	5	20	3	/	20	72 000
Dry	/	1	3	20	5	/	30	7 200
Blood Wet	/	/	5	20	2	/	30	432 000
Dry	/	2	3	5	3	1	10	8 700
<i>E. cherichia coli</i>								
Pus Wet			/	10	/		2	2 340
Dry		1	5	10	3	/	20	2 700
Blood Wet			2	10	5	/	20	16 800
Dry		1	2	5	3	/	10	10 200
<i>Streptococcus hemolyticus</i>								
Pus Wet	/		/	/	3/		1	40
Dry	1	/			1/			9
Blood Wet		1	3	3	1		5	4 752
Dry								
Controls negative—did not resist drying								
<i>Monilia albicans</i>								
Pus Wet	/	1	2	5	2			1 280
Dry		1	2	1	3	1	1	81
Blood Wet		1		2	3		1	160
Dry		1	2	2		1	3	80
Positive at end of test period								

which these experiments were performed employed a borax formalin mixture

The non proprietary disinfectants are (1) Phenol alcohol, a 95 per cent solution in distilled water of carbolic acid meeting the requirements of the United States Food and Drug Administration for phenol coefficient testing (18), 10 cubic centimeters of 95 per cent ethyl alcohol as a rinse (2) A 70 per cent solution of ethyl alcohol in distilled water (3) Five per cent cresol, compound mixture of cresols, U S P in distilled water (4)

Borax formalin, a 5 per cent solution of sodium tetraborate in 10 per cent formalin

Proprietary solutions are the following (1) Metaphen germicidal solution, aqueous, 1 2500 (2) Formaldehyde alcohol, Bard Parker formaldehyde germicide, formaldehyde 80 per cent, ethyl alcohol 67.8 per cent, methyl alcohol 9.3 per cent (3) Zephiran, alkyl dimethyl benzyl ammonium chloride, aqueous, 1 1000

Bacterial species used Eight different species were selected for study

TABLE II—SPORULATING BACILLI
Shortest test interval (hours) producing sterility

	Phenol alcohol	Alcohol 70 per cent	Creol 5 per cent	Bor formalin	Methyl n	Red Facke	Zephiran	Blad count (thousands)	
								Total	Spores
<i>B. anthracis</i>									
I									
Wet	8	15	8	1	4	1/2	1	900	50
Dry	15	+	4	1	+	5	4	900	90
Blood									
Wet	+	+	+	2	+	5	4	80 640	851
Dry	+	+	+	1	+	5	+	18	156
<i>Clostridium tetani</i>									
II									
Wet	+	+	+	15	+	15	15	63	1
Dry	+	+	+	15	+	15	+	340	72
Blood									
Wet	+	+	+	5	+	15	15	522	53
Dry	+	+	+	15	+	5	+	350	75
<i>Clostridium welchii</i>									
III									
Wet	5	+	15	4	15	1		160	
Dry	+	+	+	3	+	2	5	0	1
Blood									
Wet	5	+	5	8	5	4		54	15
Dry	1	+	+	15	+	4		7	
+D test at with 15% alcohol 1000									

+D test with 10% alcohol spore

Non sporulating (1) *Staphylococcus aureus* a hemolytic strain freshly isolated from an abscess. It was positive for coagulase and fermented lactose and mannitol. By the criteria of Chapman et al. This is a definitely pathogenic type. It withstood 1:60 dilution of phenol for 5 minutes at 0 degrees C as required in the Food and Drug Administration phenol coefficient test. (2) *Escherichia coli*, a hemolytic strain isolated from urine. (3) *Pseudomonas pyocyanica* recently recovered from a case of otitis media. (4) *Streptococcus hemolyticus* Group A (Lancefield) culture originating from acute conjunctivitis. (5) *Monilia albicans*, yeast like fungus recovered from bronchial secretion of a case diagnosed as bronchomycosis.

Sporulating (1) *Bacillus anthracis*, isolated in 1936 from a human case of anthrax. Agar plate washings from an 18 day culture in concentration of 880,000 spores per cubic centimeter withstood 100 degrees C for 2 but not for 5 minutes. (2) *Clostridium tetani* an old laboratory strain. The tetanus bacillus

was chosen because its spores are unusually resistant. An 18 day agar culture in a concentration of 21 million spores per cubic centimeter survived 100 degrees C for 20 but not for 30 minutes. (3) *Clostridium welchii* recently recovered from a case of gas gangrene. An 18 day culture with 22 million spores per cubic centimeter resisted 100 degrees C for 10 but not for 15 minutes.

Test bacterial suspensions were prepared by washing the agar cultures with 5 cubic centimeters of sterile saline solution. The exception was *Clostridium welchii* which was grown in a carbohydrate free cooked meat medium. The non spore forming bacteria were used as 20 to 24 hour cultures. *Monilia albicans* was allowed to grow for 5 days. The spore forming bacilli were tested whenever a large number of spores had developed (7 to 10 days).

TECHNICAL PROCEDURES

The ideal method for studying surgical disinfectants would employ implements obtained directly from an operative procedure. For

extensive controlled experiments, however, this is impractical. The method followed throughout the present experiments is intended to simulate as far as possible the worst surgical conditions. Detachable knife blades were immersed in mixtures of bacteria and blood or pus. Upon removal the contaminated blades were exposed to the several germicides for definite periods of time and subcultured to broth for evidence of growth. Both wet and dried blades were subjected to the test.

Preparation of blades. New No. 10 Bard Parker detachable knife blades were first treated to remove all trace of oil.¹ They were then placed in a sterile petri plate and sterilized in the hot air oven.

Preparation of bacteria body fluid mixtures. One specimen of pus, sufficient for all the tests, and containing no spores, was sterilized by heating in the water bath at 56 degrees C. Before use it was centrifuged lightly to remove coarse coagula. The other body fluid consisted of sterile citrated human blood stored for 4 or 5 days in the ice box. Four cubic centimeters of agar plate washings, free of clumps, were mixed with 6 cubic centimeters of blood or pus.

Density of bacteria body fluid mixtures. The number of bacteria present markedly influences disinfectant activity (6). If, then, one is to duplicate a condition of extreme contamination, it is necessary to know the average and greatest number of bacteria and spores to be found in actual purulent exudate. Therefore, 21 consecutive routine specimens of pus received in the hospital laboratory were utilized for this purpose. A blade dipped in the specimen was transferred to 9 cubic centimeters of saline solution and thoroughly shaken. The total bacterial count and the number of spores present were determined by dilution plates using infusion blood agar. Duplicate aerobic and anaerobic plates were poured. The sum of both plate counts was considered the total. One specimen, consisting of extremely thick pus, contained an enormous number of bacteria, a blade count of 15 million. The average blade count was 100,000. The greatest number of spores per blade was

15, the average being 2. It is conceivable, of course, that blades which had been used upon a case of gas gangrene and permitted to dry for several hours might contain several hundred spores. Therefore, an attempt was made to use bacterial suspensions yielding blade counts which were far in excess of the figures here mentioned.

Method of performing the tests. Each blade was aseptically removed from the petri plate by hooking a bent platinum needle into the hole of the blade. After being dipped into the bacteria blood mixture, it was carefully lowered into an 85 by 15 millimeter tube containing 5 cubic centimeters of disinfectant solution. Each blade was placed in a separate tube of germicide. Following the desired exposure the blade was removed, rinsed in a tube containing 10 cubic centimeters of broth, and transferred at once to a second tube of broth where it remained throughout the period of incubation. Rinsing was accomplished by shaking the blade vigorously in the broth for 5 seconds. This procedure was followed throughout except for the phenol series which received an additional rinse in 95 per cent alcohol, and the Zephiran blades with which 2 broth rinses were necessary to overcome bacteriostasis. Both the rinsing and the final broth tubes were incubated for evidence of growth. The length of incubation varied from 6 to 14 days at 37 degrees C. The presence of the metal blade frequently produced a turbidity and precipitate in the broth. Black sulfide was formed by the anaerobes. As a result, all the broth tubes in which growth was not grossly evident were examined microscopically for the presence of bacteria.

A duplicate set of blades was treated as above except that, upon removal from the bacteria blood mixture, they were dried at 37 degrees C. for 6 to 8 hours. Aseptic conditions were maintained by placing the blades in a sterile petri plate containing an ordinary glass slide, in such a manner that they were supported at one end by the slide. At a different time the entire experiment was repeated, and in this experiment pus instead of blood was used as the mixture fluid. All tests were conducted at room temperature approximately 27 degrees C.

¹I am grateful to the Bard Parker Company for the large number of blades necessary for this study.

Time of exposure to the disinfectants The non sporulating organisms were exposed for $\frac{1}{2}$, 1, 2, 3, 5, and 10 minutes. In some instances it was necessary to repeat the test using longer exposure times. The spore forming bacilli were tested after intervals of 5, 15 and 20 minutes, 1, 2, 4, 8, and 18 hours in the case of wet blades. The dried blades were not always cultured at the 5 minute or the 8 hour periods.

Media employed The nutritive quality of the recovery medium has been shown to be of paramount importance in the testing of germicides since an organism surviving a killing factor is more fastidious in its growth requirements (3, 13). Sabouraud's dextrose broth (Difco) was used for *Monilia albicans*, beef infusion broth prepared according to Wright for *Streptococcus hemolyticus* and brain heart infusion broth (Difco) containing 0.05 per cent cysteine hydrochloride for the anaerobic bacilli. For the remaining organisms the recovery medium consisted of Liebig's meat extract, 0.5 per cent Difco proteose peptone, 1.0 per cent sodium chloride, 0.5 per cent. In all instances 10 cubic centimeter volumes of broth were employed.

Anaerobic technique The anaerobes *Clostridium tetani* and *Clostridium welchii* were incubated according to the method of Weiss and Spaulding. Luxuriant growth is regularly obtained in 24 hours.

Controls The importance of and necessity for separating bacteriostasis from bactericidal power has been repeatedly emphasized (6, 9, 11). The bacteriostatic ability of each of the above solutions had been determined previously under the test conditions. Nevertheless a set of control blades was included in each experiment. Sterile saline solution was substituted for the bacterial washings. Blades immersed in blood were exposed to the germicide and transferred to broth with the customary rinses. Each tube was then inoculated with 0.1 cubic centimeter of a 1:10,000 dilution of the bacteria body fluid mixture being used.

By count it had been found that the number of bacteria inoculated to the control tubes in this manner was approximately one two hundredths of that present on the test

blades. In addition one member of each set of dried blades was placed in salt solution instead of germicide, and subcultured to test the ability of the organism to withstand drying. The hemolytic streptococcus in one instance, did not survive. It has been shown by Murray and Headlee (7, 14, 15) that the drying process frequently decreases the thermal resistance of bacteria.

Experimental data The accompanying tables present the detailed data. The figures given represent the first test period at which the corresponding tubes failed to show growth.

CORROSION TESTS

During the course of the experiments it seemed advisable to compare the corrosive action of the several chemical agents. To be satisfactory for practical usage a chemical solution must be not only germicidal but non corrosive as well.

Ten knife blades (oil removed but not previously used) were placed in each of 7 flasks containing 50 cubic centimeters of the respective germicides. For 5 weeks the flasks remained stoppered, during an additional 5 weeks they were allowed to remain open to the air. Storage was maintained at room temperature.

Results The cresol borax formalin and Bard Parker formaldehyde solutions showed no evidence of corrosion after 10 weeks. Metaphen produced very slight corrosion beginning at the end of the second week which did not progress further. Zephiran, 95 per cent phenol, and 70 per cent alcohol began to corrode after 24 hours to 2 days. With phenol and alcohol this became extreme in 2 weeks. Zephiran produced extreme corrosion by the end of the sixth week.

ANALYSIS OF STUDY

From an examination of the accompanying tables it becomes obvious that the vegetative forms of bacteria are rapidly destroyed by these chemical agents even when they are dried in the presence of body protein. If one were dealing therefore only with the non sporulating cell, the chemical sterilization of instruments might be rapidly accomplished with a high degree of safety.

Bacterial spores, however, are extremely resistant to physical and chemical factors. When one recalls that the spore of *Bacillus anthracis* will withstand boiling for 10 minutes, that of *Clostridium welchii* for 5 minutes, and the tetanus spore from 15 to 90 minutes (21), it is indeed not surprising that most of these chemical solutions do not sterilize spore contaminated blades within 18 hours. The borax formalin and the formaldehyde alcohol solutions appear to be the best spore killing agents. Only these 2 germicides destroyed all 3 types of spores regularly within 18 hours. In this connection Scott has reported the superiority of formaldehyde over phenol in sterilizing anaerobic cultures.

The data reveal striking evidence of variation among different species. The difference in susceptibility of bacterial species to a single agent has been clearly pointed out by Garrod (5). In the present experiments, for instance, Zephuran was excellent for killing *Staphylococcus aureus* under the test conditions, but relatively inactive against *Pseudomonas pyocyanea* or *Escherichia coli*. It is of some interest that 95 per cent phenol is a superior bactericidal agent for vegetative forms but poor as a sporicide.

No attempt has been made to study the tendency of the different solutions to leave a residue on instruments after removal from the solution, their ability to penetrate the joints or crevasses of hinged instruments, the effect of continued usage, or the liberation of irritating fumes. These factors are subjects for further investigation.

Likewise, no consideration has been given to the practice regularly followed by those who have adopted chemical sterilization, of washing the instruments before immersion in the disinfectant. Because this desirable step is obviously subject to considerable variation, it may best be viewed as providing a wide and highly desirable margin of safety.

CONCLUSIONS

1. Four non sporulating species of bacteria, 3 sporeformers, and a yeast like fungus were exposed to 7 different chemical solutions widely used for the chemical sterilization of surgical instruments.

2. A practical laboratory method for testing such disinfectants in the presence of blood or pus is suggested.

3. With one exception the non sporulating organisms failed to survive an exposure longer than 30 minutes.

4. Bacterial spores were, on the other hand, highly resistant. Four of the solutions were not effective within the time limit used. The formaldehyde alcohol and the borax formalin solutions appeared to be the best sporicidal agents.

BIBLIOGRAPHY

1. ANONYMOUS. How surgical equipment is sterilized. *Modern Hosp.* 1932 38 98.
2. CHAPMAN G. H. BERENS C. NELSON E. L. and CURCIO L. G. The differentiation of pathogenic staphylococci from non pathogenic types. *J. Bact.* 1930 35 311.
3. CURRAN H. R. and EVANS F. R. The importance of enrichments in the cultivation of bacterial spores previously exposed to lethal agencies. *J. Bact.* 1937 34 179.
4. ECKER E. E. and SMITH R. Sterilizing surgical instruments and utensils. *Modern Hosp.* 1937 48 92.
5. GARROD L. P. Laboratory testing of disinfectants. *Brit. M. J.* 1935 1 5.
6. Idem. Effect of bacterial numbers on minimum bacteriostatic concentrations. *J. Infect. Dis.* 1935 57 247.
7. HEADLEE M. R. Thermal death point. III. Spores of *Clostridium welchii*. *J. Infect. Dis.* 1931 48 468.
8. LEONARD G. F. Limitations of phenol coefficient tests in determining germicidal activities. *J. Infect. Dis.* 1931 48 358.
9. LEONARD G. F. and HEACOCK E. A method for determining the germicidal power of products which have a high bacteriostatic activity. *Am. J. Pharmacol.* 1933 105 241.
10. LEUSDEN FR. P. and VON BREMEN G. Sterilization von Instrumenten in kochenden Desinfektionslösungen (Baktol Carvassept Sagrotan und Zephrol). *Ztschr. f. Hyg. u. Infektionskrankh.* 1937 120 247.
11. MARSHALL M. S. and HRENOFF A. K. Bacteriostasis. *J. Infect. Dis.* 1937 61 42.
12. McCULLOCK E. C. and COSTIGAN S. A comparison of the efficiency of phenol, liquor cresolis, formaldehyde, sodium hypochlorite and sodium hydroxide against *E. typhi* at various temperatures. *J. Infect. Dis.* 1937 59 281.
13. MORRISON E. W. and RETTGER L. F. Bacterial spores. II. A study of bacterial spore germination in relation to environment. *J. Bact.* 1930 20 313.
14. MURRAY T. J. Thermal death point. II. Spores of *Bacillus anthracis*. *J. Infect. Dis.* 1931 48 457.
15. MURRAY T. J. and HEADLEE M. R. Thermal death point. I. Spores of *Clostridium tetani*. *J. Infect. Dis.* 1931 48 436.
16. REDDISH G. F. Methods of testing antiseptics. *J. Lab. & Clin. Med.* 1929 14 649.
17. REDDISH G. F. and BURLINGAME E. M. A method for the bacteriologic testing of chemical solutions used

- for the cold sterilization of surgical instruments
J Bact 1938 36 265
- 18 RUEHLE G L A and BREWSTER C M U S Food
and Drug Administration Methods of Testing anti-
septics 1931 Circular No 198 United States De-
partment of Agriculture
- 19 SCOTT J P The action of phenol and formal on
aerobic and anaerobic organisms J Infect Dis
1928 43 90
- 20 SOBERNHEIM G Ueber Instrumentensterilization
Med Wehnschr 1932 62 1034
- 21 TOPLEY W W C and WILSON C S The Principles
of Bacteriology and Immunity Pp 662 696 and
698 Baltimore William Wood & Co 1916
- 22 WEISS J F and SPAULDING E H A simple method
for obtaining effective anaerobiosis J Lab &
Clin Med 1937 22 726
- 23 WAIGHT H D The preparation of nutrient agar with
special reference to pneumococci streptococci and
other gram positive organisms J Path & Bacte-
riol 1934 39 359
- 24 ZIMMER H and BAYNE JONES S A Textbook of
Bacteriology P 683 New York D Appleton
Century Co 1934

THE SIGNIFICANCE OF CEVITAMIC ACID DEFICIENCY IN SURGICAL PATIENTS

JOHN A. WOLFFER M.D. F.A.C.S., and FREDERICK C. HOFBEL M.D.,
Chicago, Illinois

THE motive which led to the study of the problem to be presented was created over a period of years of close observation of postoperative complications. It must be apparent to every surgeon that frequently serious postoperative complications occur which demand some sort of explanation and perhaps prevention. Of these non-healing of wounds is expressed by evisceration, postoperative hernia or incomplete disruption of a wound, peritonitis from a leaking suture line and non-union of fractures take a ranking position. Secondly one may also allude to hemorrhage, wound infection, disturbances in function such as delayed gastro-intestinal motility, loss of appetite with increasing weakness and prostration, nausea and vomiting, respiratory infections and the like.

In a communication during 1935 attention was called to the nutritional status of the surgical patient and two elements of malnutrition were stressed, namely, protein deficiency and avitaminosis. An interchange of ideas with Graham, of London, finally focused our attention on cevitic acid deficiency.

Scurvy is a disease which has been recognized for many centuries although until quite recently its nature was a mystery. Hippocrates described it quite accurately. It is interesting to read an account of the ravages of scurvy in Lord Anson's fleet during a voyage around the world in 1740-44 as described by Richard Walter, chaplain on board the 'Centurion' published in London in 1750. In writing of the disease he states:

This disease is likewise attended with a strange dejection of the spirits and with shiverings, tremblings and with a disposition to be seized with the

most dreadful terrors on the slightest accident. Indeed it was most remarkable in all our reiterated experience of this malady that whatever discouraged our people or at any time damped their hopes never failed to add vigor to the distemper for it usually killed those who were in the last stages of it and confined those to their hammocks who were before capable of some kind of duty so that it seemed as if alacrity of mind and sanguine thoughts were not contemptible preservations from its fatal malignity. It often produced putrid fevers, pleurisy, the jaundice and violent rheumatic pains and sometimes it occasioned an obstinate costiveness which was generally attended by a difficulty of breathing and this was esteemed the most deadly of all scorbutic symptoms at other times the whole body and more especially the legs were subject to ulcers of the worst kind attended with rotten bones and such a luxuriance of fungous flesh as yielded to no remedy. But a most extraordinary circumstance and what would scarcely be credible upon a single evidence is that the scars of wounds which had been for many years healed were forced open again by this virulent distemper. Of this there was a remarkable instance of one of the invalids on board the Centurion who had been wounded above fifty years before at the battle of the Boyne for though he was cured soon after and had continued well for a great number of years past yet on being attacked by the scurvy his wounds in the progress of the disease broke out afresh and appeared as if they had never healed nay what is still more astonishing the callus of a broken bone which had been completely formed for a long time was found to hereby dissolve and the fracture seemed as if it had never been consolidated.

This amazing report opens the door to some well chosen speculation such as the effect of excitation and fear upon cevitic acid metabolism especially as associated with the adrenal glands, also, wound healing. Further reference may be found concerning wound healing as associated with scurvy in the *Medical and Surgical History of the War of the Rebellion* in which in describing the clinical picture of scurvy it is written:

This was further manifested by the indisposition of wounds to heal slight scratches becoming converted into indolent ulcers or affected with erysipelas

From the Division of Surgery (Tumor Clinic) Northwestern University Medical School

The expenses of this research were defrayed in part by the Lloyd E. Patterson Memorial Fund

Presented before the Chicago Surgical Society April 7, 1939

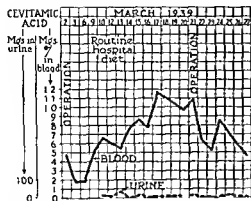


Chart 3. B. V. Male aged 57 years. Diagnosis: carcinoma of the rectum. Bloody and watery stools for 1½ years and loss of 50 pounds of weight in past 2 years. Home diet balanced but meager. Colonotomy on March 2, 1939, and closure of distal loop on March 21, 1939. He was on routine hospital diet while the ascorbic acid studies were made.

healed duodenal mucosa failed to heal in vitamin C deficient guinea pigs but healed promptly in the control animals. They also demonstrated a marked tendency to spontaneous formation of peptic ulcers in the deficient animals as compared with an almost negligible tendency in the control animals.

We have checked the blood ascorbic acid levels on numerous patients and have had the opportunity to follow blood, urine, and feces levels on deficient patients who have come to surgery to saturate these patients and then to note their wound healing. In all of the

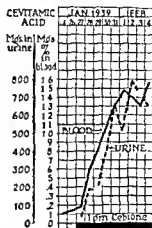


Chart 4. C. A. Male aged 57 years. Diagnosis: peptic ulcer of the posterior gastric wall. History of pain and distress for 4 months with a weight loss of 35 pounds. Almost daily vomiting for 4 months. Restricted diet and frequent use of bicarbonate of soda to control pain. Gastric resection with anterior loop anastomosis on February 22, 1939. The observations and ascorbic acid administration were carried on until the patient was discharged but are not indicated in the chart because they were not of special interest. Total amount of vitamin C excreted in the stool on February 4, 1939, was 575 milligrams while the blood level was high—15.5 milligrams per cent and the urinary excretion for the day was 637.35 mg.

cases to be discussed the blood and urine determinations were made by titration with 2,6-dichlorophenolindophenol. The Farmer-Abt microblood technique being used for the blood determinations.

The usual method of saturation was to give 1 gram of ascorbic acid (Merck) daily. This was given intravenously to avoid errors in absorption as might be the case in vomiting, gastric stasis, and the like. The ascorbic acid was mixed with one half gram of soda bicarbonate and diluted with distilled water to a volume of approximately 30 cubic centimeters just before administering in order to reduce irritability in the venous system.

Our impression of the significance of the various blood levels is depicted in Chart 1. The highest figure we have found recorded on a patient with scurvy symptoms was 0.35 milligrams per cent. Therefore this figure must delimit the scurvy from the subnormal group at least for the present. On the other hand it is entirely possible for an individual to have a blood level considerably below this figure and not show symptoms of scurvy; the most likely explanation being that a lowered



Fig. 1. Mr. C. A. aged 57 years. Gastric resection for perforating type of peptic ulcer. Appearance of wound 1 month after operation.

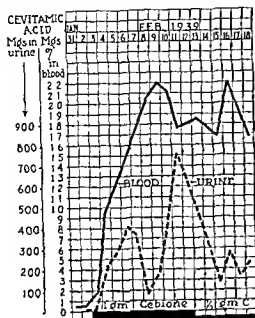


Chart 5 J K Male aged 54 years. Diagnosis extensive peptic ulcer of the lesser curvature of the stomach. The first ascorbic acid estimation was made 1 month after admittance to the hospital during which time he had extensive alkaline therapy and restricted diet. No operation was performed. He excreted 7.03 milligrams of vitamin C in his stools on February 3, 1939, at which time the blood level was 0.18 milligrams per cent and the urinary excretion for the day was 2.82 milligrams.

blood level is followed at a considerably later period by tissue changes.

This latter fact again is important in attempting to define an optimum level which we indicate as varying from 0.6 to 1.5 milligrams per cent. The optimum and pre-scurvy groups actually overlap more than is indicated. A vitamin C balanced person, who because of an operative procedure or infection utilizing more vitamin C or who is deprived of a vitamin C intake for several days, may have a low blood level, but will respond quickly to an intake of orange juice or pure cevitic acid. Conversely, a truly subnormal person given a large dose of cevitic acid will have a sudden elevation in the blood ascorbic acid level but he cannot maintain this level unless the intake remains high while the tissues are becoming saturated.

Chart 2 illustrates the blood ascorbic acid levels on a group of students from 19 to 30 years of age. In several instances markedly low values are indicated and histories of C deficient diets were obtained. Otherwise, the list is quite representative of any group of

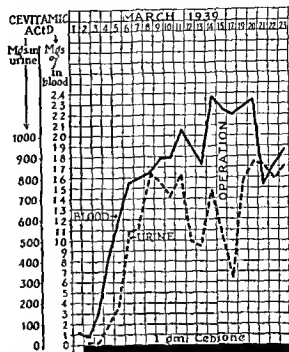


Chart 6 W H Male aged 47 years. Diagnosis colloid carcinoma of the stomach. History of abdominal discomfort for 1 year with frequent use of bicarbonate of soda. Only occasional vomiting. The patient took an average amount of fruit juice and did not restrict his diet notably. Posterior gastro-enterostomy was performed on March 15, 1939.

average normal individuals upon fairly balanced diets. The several low values are of note because they illustrate the tendency to eliminate the vitamin C containing foods when under economic stress.

The following case illustrates what may be considered the average cevitic acid levels of the ordinary surgical case and indicates that a well balanced hospital or home diet will maintain an individual.

B V, a male clinic patient 56 years of age, entered Passavant Memorial Hospital with a diagnosis of carcinoma of the rectum. His home diet was not restricted except as was necessarily due to a meagre family budget. His original blood level was 0.4 milligrams per cent (Chart 3) and therefore in the subnormal group as we should expect. But studying the chart we find he responded well to the vitamin C content of the average hospital diet so we feel that he did not have a tissue depletion. His urinary output of vitamin C was very low at all times illustrating that he was using most of his intake to maintain his blood and tissue levels. There is shown the typical postoperative depression in the blood level and urinary output.

Patients with gastric disease in the majority of instances use alkalies and a very restricted

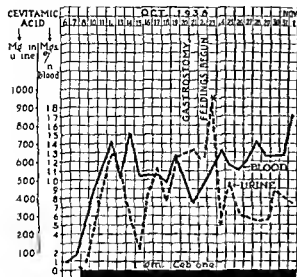


Chart 4. S. Male aged 72 years. Diagnosis carcinoma of the middle third of the esophagus. History of substernal distress after eating, dysphagia growing progressively worse and a loss of 40 pounds in 3 months previous to entrance to the hospital. On October 10, 1938, 4.53 milligrams of vitamin C were excreted in the stools and on October 14 only 0.04 milligrams with a blood level of 1.50 milligrams per cent and a urinary excretion of 281.18 milligrams. On the 17th, 18th and 19th of October the stools contained 1.7, 1.04 and 0.25 milligrams of vitamin C. During this time the blood levels were high and the maximum daily urinary excretion was 626.45 milligrams. Asterisk indicates error in the separation of the specimens of October 23 and 24.



Fig. 2. Mr. V.S. aged 72 years. Gastrotomy for carcinoma of the esophagus. Appearance of patient 5 months after operation. Note the tanning of chest from deep x-ray therapy. Appearance of gastrotomy and emaciation. Weight gain of 15 pounds in eight since operation.

diet both because they find that they are more comfortable on that regimen and also because the use of alkalis is the basis of most peptic ulcer therapeutics. Therefore in this type of case the blood ascorbic acid levels are low and there is often present a tissue depletion. The following case reports are illustrative.

C. A. male clinic patient 57 years of age entered Passavant Memorial Hospital with a diagnosis of peptic ulcer. There was a history of epigastric pain and distress for 4 months and a weight loss of 35 pounds. His diet was voluntarily limited to very soft bland foods and he used soda bicarbonate frequently during the day. His first blood ascorbic acid level was 0.1 and 0.13 milligrams per cent (Chart 4). He was given a gram of cebione intravenously every day and in 3 days the blood level rose to normal and he excreted a large percentage in the urine. He was operated upon because of a suspicion that carcinoma was present and approximately two thirds of the stomach was resected and an anterior pyloric anastomosis was done. The clips were removed on the fourth postoperative day and his course while in the

hospital was quite without event. The wound healed promptly (Fig. 1).

J. R. a male clinic patient 54 years of age entered Passavant Memorial Hospital with an extremely large lesser curvature ulcer. When first seen he had a history of having taken on advice of a friend a teaspoonful of mustard seed daily for 2 weeks as a cure for rheumatism. Such violent spasms of epigastric pain ensued that he had to take several teaspoonfuls of soda bicarbonate every 10 to 20 minutes for 10 days previous to admittance to the hospital. His diet had been restricted to milk, much of which he vomited. In the hospital he was placed on a bland diet and continuous Amphogel drip through a gastric Levine tube. One month later the blood ascorbic acid determination was 0.045 milligrams per cent (Chart 5). After a single dose of 1 gram of cebione the blood level rose to a normal—0.9 milligrams per cent—and remained above optimum limits during the remainder of the period of observation. The urinary output on the fourth day after cebione was started was 405 milligrams for the 24 hours. However the urinary excretion of vitamin C again

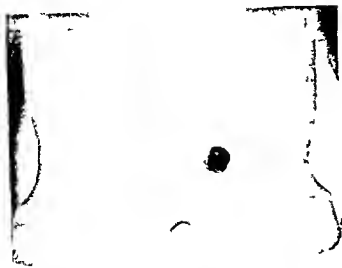


Fig 3 Close up of wound and gastrostomy shown in Figure 2 to show character of wound healing

dropped as low as 87 milligrams per 24 hours and finally reached a normal excretory level for a daily dose of 1 gram of cebione (744 mgm excreted per 24 hours) on the ninth day after cebione was begun. When the daily dose of cebione was cut to $\frac{1}{2}$ gram daily the total excretion dropped sharply whereas the computed absorption of vitamin C and the blood ascorbic acid level remained constant.

In this case the alkaline therapy was more rigorous and as a result the original blood level

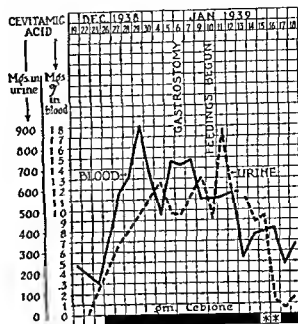


Chart 8 S. A. Male aged 69 years. Diagnosis advanced carcinoma of the cardiac end of the esophagus. Symptoms of esophageal obstruction for 8 weeks. Loss of 25 pounds of weight in past year. Stools on January 18 1939 contained 0.37 milligrams vitamin C. Asterisk indicates error in computing dosage.

was lower than in the preceding case. Also in this case is well illustrated the fallacy of taking the first high blood level to indicate saturation.

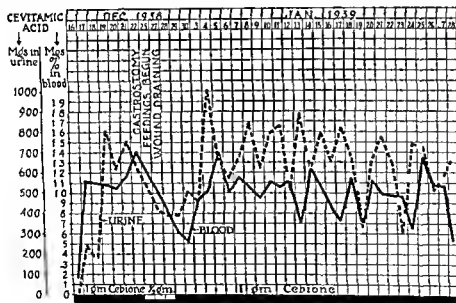


Chart 9 S. L. Male aged 50 years. Diagnosis carcinoma of the middle third of the esophagus. History of substernal pain, vomiting of food and coughing for 3 months. Had deep radiation therapy over site of lesion and had had x-ray evidence of spread of the lesion into the hilus of the left lung. Estimation of amounts of vitamin C in the stools showed on December 30 1938 1.01 milligrams and on January 6 1939 1.0 milligrams and on January 23 1939 1.01 milligrams.



Fig. 4. Mr. I. C. aged 70 years. Jejunostomy for carcinoma of lower third of esophagus and cardia. Appearance of patient 1 month after operation.

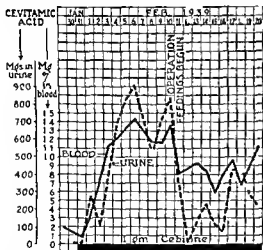


Chart 10. L. C. Male aged 63 years. Diagnosis carcinoma involving the cardiac end of the stomach and lower end of the esophagus. Progressive dysphagia and vomiting of 8 months duration. Weight loss of approximately 40 pounds. Urinary retention upon admission to the hospital. Jejunostomy was done on February 10, 1939.

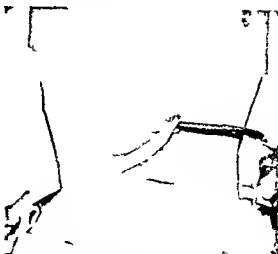


Fig. 5. Closure of wound in Figure 4 to show character of healing.

W. H. a male clinic patient 47 years of age entered Las Vegas Memorial Hospital with a diagnosis of carcinoma of the pyloric end of the stomach. He had symptoms of gastric distress for 1 year but had vomited only on several occasions. He had not restricted his diet and on the basis of his history we had reason to believe that he had a better intake of orange juice than the first patient with carcinoma of the rectum who had a blood ascorbic acid level of 0.4 milligrams per cent. However his original blood

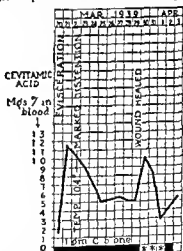


Chart 11. C. I. Female aged 47 years. Diagnosis ectropia of the bladder. Implantation of ureters into the colon. Lower midline incision. Eviscerated on the sixth postoperative day. Resutured on March 20, 1939. Patient later developed intestinal obstruction and on April 10, 1939 the abdomen was again opened through a left lower rectus incision to free adhesions. Healing again occurred promptly and without event. Asterisk indicates that no cevitamine was given because of error.

ascorbic acid level was 0.12 milligrams per cent (Chart 6). Investigation revealed that he had taken a total of about a pound of soda bicarbonate weekly to control his pain. Two days after starting cebione the blood reached a normal level and on the seventh day the urinary output indicated a probable tissue saturation. After operation there was a slight drop in urinary excretion of ascorbic acid, probably indicating a slight increase in utilization of cevitic acid.

In a recent communication on the subject of wound disruption and postoperative hernia, Singleton and Blocker state "It is common knowledge that wound healing is delayed in patients showing emaciation, general debility, or old age, and this is especially noticeable in patients with cancer." They further point out that of the 160 cases of disruption they reviewed, 22 per cent were not accompanied by the local contributing factors of infection or hematoma but there was merely a non-union of the wound margins.

The next few cases reported therefore, should have been ideal candidates for failure of wound healing and disruption.

A S, a male clinic patient 72 years of age entered Passavant Memorial Hospital with a diagnosis of carcinoma of the middle third of the esophagus. He was emaciated having lost 40 pounds in the 3 months before entering the hospital. His original blood ascorbic acid levels were 0.08 and 0.16 milligrams per cent (Chart 7).

He was prepared with cebione in the usual manner and was also given what liquids high in protein and carbohydrate that he could still swallow, supplemented by intravenous glucose and salt solution. A Spivack type gastrostomy was done through a left upper rectus incision. He wished to be up in a wheel chair the next day and was allowed to do so. Feedings were started through the gastrostomy tube on the third postoperative day. The wound edges did not separate and no herniation or keloid formation has occurred 7 months after operation (Figs 2 and 3).

S K, a male clinic patient, aged 69 years, entered Passavant Memorial Hospital with a diagnosis of advanced carcinoma of the inferior end of the esophagus (Chart 8). He had symptoms of 8 weeks duration and a loss in the past of at least 25 pounds of weight. He was similarly prepared and a Spivack gastrostomy was done. He left the hospital on the eleventh day after operation. One week later he became irrational, comatose, and died 2 weeks after being discharged.

This case is interesting because, although his general condition from the time we first saw him was that of a rapid downhill course

of an advanced malignancy, his wound healed as rapidly as did that of the previous case, and the gastrostomy functioned perfectly up to the time of his death.

S L, a male patient, aged 50 entered Passavant Memorial Hospital with an advanced carcinoma of the middle third of the esophagus. He had received radiation therapy and had early evidence of spread of the carcinoma into the mediastinum and hilus of the left lung. He was prepared in the same manner as the previous cases (Chart 9). On the third postoperative day a temperature elevation and chill indicated infection and the next day the wound was opened inferior to the gastrostomy and foul pus was evacuated. Several days later gastric secretion was evident in the wound. The patient had persistent paroxysms of coughing which became slowly but progressively worse. Despite these handicaps the infection cleaned up and the wound granulated in with remarkable rapidity. Such is entirely contrary to the usual course of gastrostomy wounds with the three complicating factors of infection, gastric secretion in the wound, and paroxysms of severe coughing.

L C, a male clinic patient 70 years of age, entered Passavant Memorial Hospital with a diagnosis of carcinoma of the lower end of the esophagus and cardia. He had lost 40 pounds of weight in the several months preceding hospitalization. On the first day in the hospital he developed urinary retention due to an enlarged prostate and thereafter had a mild urinary sepsis. Preparation was as in the previous cases plus a retention catheter (Chart 10). When his temperature leveled off below 100 degrees F a jejunostomy was performed because a gastrostomy was not feasible in face of the extensive involvement of the cardiac end of the stomach by carcinoma.

Besides the ease with which the wound healed (Figs 4 and 5), this case is also interesting because of the sharp drop in the blood ascorbic acid levels and the urinary excretion of vitamin C beginning with the time that jejunal feedings were started, thus despite intravenous cebione. Experiments upon guinea pigs have shown that at least in that animal the upper intestine is one of the main sites of storage of vitamin C. Did the disturbance of jejunal physiology attendant upon feedings directly into its lumen cause this drop in blood ascorbic acid level?

The question may arise as to whether any cases of wound disruption have been checked for blood cevitic acid levels. One case that we know of is reported in the literature in which evisceration occurred and although the blood ascorbic acid level had not been deter-

mined the autopsy findings showed other early evidences of scurvy. We may also add one case of carcinoma of the esophagus with gastrostomy in which there was a mild wound infection followed by a slow but complete dissolution of the wound. The blood ascorbic acid level taken after wound separation was 0.03 milligrams per cent.

The second case C. L., a female patient 4 years of age, entered Passavant Memorial Hospital with an ectropion of the bladder for the second stage of the procedure of implanting the ureters into the pelvic colon (Chart 11). She eviscerated on the sixth post-operative day. A blood ascorbic acid taken at the time of evisceration was 0.16 milligrams per cent. One gram doses of cebrone were started immediately and the blood responded promptly. There was a secondary drop which was due either to high temperature, the infection in the wound, or to the distention causing disturbances of the intestinal physiology. However, the wound healed firmly despite marked distention and stitch abscesses to complicate the process.

CONCLUSIONS

1. Although at present there is no absolute proof of the relation of vitamin C deficiency to non union of wounds in humans, there is considerable evidence, historical, pathological, experimental, and clinical, to give strong support to the theory that a relationship exists and to encourage further study, particularly in the clinical field.

2. If the blood ascorbic acid is low and is accompanied by a history of deficient or defective alimentation of foods containing vitamin C, the patient may be considered to have also a tissue depletion.

3. Patients deficient in vitamin C may be saturated by large doses of synthetic cevitamic acid administered either by mouth or intravenously, or by adequate feedings of foods rich in vitamin C.

4. The deficient patient cannot be considered saturated until the blood level has been maintained at optimal or above for a sufficient period. These should be verified by a high urinary excretion. The latter can be determined only when the daily intake of vitamin C is known.

When such determinations are not available, the deficient patient should be saturated with doses of 1 gram of cevitamic acid daily for a

period of 9 to 10 days and then maintained on doses of about 300 to 500 milligrams of cevitamic acid daily until the wound is healed. The patient may then be kept saturated on a diet including adequate vitamin C containing foods.

5. The excretion by way of feces of vitamin C is negligible except in the presence of hypermotility of the small intestine or in alcoholics.

6. Vitamin C deficiency should be thought of and determinations made in the following types of patients: (a) Those with a deficient diet—voluntary, because of low income, or because of a doctor's dietary orders; (b) those taking large doses of alkalis by mouth; (c) those with obstructive gastrointestinal lesions, particularly at the pylorus or above; (d) those with a history of vomiting over long periods; (e) those with hypermotility of the small intestine; and (f) syphilitics and alcoholics.

7. After operation, normal patients may show a drop to scurvy levels because of long periods of intravenous therapy without food by mouth, because of abnormal bowel physiology, and because of the increased utilization of vitamin C that apparently accompanies infections and operative procedures.

We wish to express our appreciation to Dr. Chester Farmer and the Division of Chemistry for their assistance.

BIBLIOGRAPHY

1. ARCHER, H. E. and GRAHAM, G. On the excretion of ascorbic acid. *Lancet* 1936 230 710-713.
2. Idem. The subscurvy state in relation to the presence of gastric and duodenal ulcer. *Lancet* 1936 231 364-366.
3. ASCHOFF, K. A. L. and KOCH, W. *Der Skorbut*. Jena: Gustave Fischer, 1919.
4. IVE, F. F. On the health of the Southern Army. *Nashville J. M. & S.* 1866 n. s. 1 12-32.
5. FARMER, C. F. and AUST, A. F. Determination of reduced ascorbic acid in small amounts of blood. *Proc. Soc. Experimental Biol. & Med.* 1936 34 146-150.
6. FAUNHOLT, A. An account of the ravages of scurvy in Lord Anson's fleet during a voyage around the world, 1740-44, and some notes concerning British naval hygiene at that time. *Military Surgeon* 1909 25 38-47.
7. HART, E. B., STEENBOCK, H. and SMITH, D. W. Effect of heat on the antiscorbutic potency of milk products. *J. Biol. Chem.* 1919 38 305.
8. HESS, A. F. *Scurvy*. Past and Present. Philadelphia and London: J. B. Lippincott Co., 1920.
9. HÖFER, J. A. Studies in scurvy. *Acta paediat. supp.* 1924 3 34.

- 10 HOLST H, and FROELICH T Experimental studies relating to ship beriberi and scurvy *J Hyg* 1907 7 634
- 11 JACOBSEN E On the storage of ascorbic acid in the intestinal wall of the guinea pig *Acta med Scand* 1935 85 419-424
- 12 JENEY, A V and TORO E Die Wirkung der Ascorbinsäure auf die Faserbildung in Fibroblastkulturen *Arch f path Anat, etc*, 1937 98 87-97
- 13 KIRK C G The physiology of vitamin C *J Am M Ass*, 1938 111 1093-1101
- 14 KLODT W Influence of bile on resorption of vitamin C *Med Welt* 1936 10 477
- 15 LANMAN, T, and INGALLS T Vitamin C deficiency and wound healing *Ann Surg* 1937 105 616-625
- 16 McLESTER J S Nutritional failure as a clinical problem *South M J* 1935 28 254
- 17 Medical and Surgical History of the War of the Rebellion Part III vol 1 *Med vol 3 Gov Print Off* 1888 705
- 18 PAYNE, SIR REGINALD The post mortem findings after partial gastrectomy *St Bartholomew's Hosp Reports*, 1936 p 69
- 19 SINGLETON, J O and BLOCKER, T G Disruption of abdominal wounds and postoperative hernia *J Am M Ass* 1939 112 122-127
- 20 SMITH D, and MCCONKEY, M Peptic ulcers occurrence in guinea pigs fed on diet deficient in vitamin C *Arch Int Med* 1933 51 413-4 6
- 21 TAEFFEL M and HARVEY S C Effect of absolute and partial vitamin C deficiency on the healing of wounds *Proc Soc Exp Biol & Med* 1938 38 518-527
- 22 WOLBACH S B Controlled formation of collagen and reticulum, a study of the source of intercellular substance in recovery from experimental scorbutus *Am J Path* 1933 9 689-700
- 23 WOLFFER, J A A consideration of the nutritional status of the surgical patient *Surg Gynec & Obst* 1936 63 607-616

SWEATING FUNCTION OF TRANSPLANTED SKIN

HERBERT CONWAY MD FACS New York New York

THE regeneration of sensation in transplanted skin has been the subject of recent study by several investigators. The varied findings as reported have given rise to academic discussion as to the type of graft in which sensation is re established earliest and the mechanism by which the nerve supply is restored.

Kredel and Evans in 1933, J. S. Davis and Kitlowski in 1934 and Loyal Davis in 1934 have reported studies which show that sensation returns earliest and is most complete in transplants of skin which have been moved to their new locations by means of pedunculated flaps. Next in rate of return of sensation was the whole thickness graft, then the thick split and finally the Ollier Thiersch graft. Their observations showed that the rate and degree of return of sensation are directly proportional to the thickness of the graft. Further evidence was submitted in agreement that the return of sensation begins at the periphery of the graft in its proximal portion, progressing distally and from the sides. In disagreement with these findings is the report of McCarroll in 1938 in which a detailed study of 58 grafts is recorded. He found that in thick split grafts the regeneration usually occurs simultaneously over the entire graft and that in this type of graft the return is more rapid than in any other. The clinical importance of this academic argument lies in the necessity for the choice of a graft in which the earliest return of good sensation can be expected for covering defects where sensation is needed for proper function. Surgical literature abounds with comparisons of the relative merits of the different free grafts of skin, preference being given to the thick split graft by some authors who emphasize its ease of application. By others the whole thickness graft is preferred because it is movable on the

underlying tissues because it resists potential contraction and withstands ordinary cutaneous trauma and because it matches the adjacent skin better not only in color but also in texture.

In the many neurological studies made with regard to return of sensation in grafts little mention is made of the sweating function of the skin after transplantation. Since the secretion of moisture onto the surface of one type of graft would make it preferable to others, a comparative study of the sweating function of the various types of skin grafts has been carried out. Information has been gathered from observations on 75 grafts. Only 7 references have been found in the literature concerning the sweating function of transplanted skin. Kredel and Evans reported a case of Phemister's in which a vascular flap used for reconstruction of the upper lip was observed to sweat only at the upper angles and along one border of the flap. Brief reference was made to another case in which a pedunculated flap transplanted from one leg to the other showed a few small areas of sweating in its upper portion. Guttman reported observations of the sweat test on one case in which tissue had been transplanted from the anterior thoracic region to the hand by means of a tubed flap. Because the transplanted tissue sweated profusely and to the same degree as the skin of the thoracic wall he inferred that sweat glands in skin transplanted by means of tubed flaps retain the sweating function of the donor area.

It is at once apparent that a number of factors may influence findings in the study of the sweating function of the skin. Consideration of the histological structure of the skin of the donor area is of first importance since sudoriparous glands are few in the skin and subcutaneous tissues over some parts of the body and abundant in others. Likewise the condition of the bed to which the graft is transplanted represents a factor since scar tissue, deep to the graft, may prevent the vas-

From the Department of Surgery of the New York Hospital and Cornell Medical College.
Read before the Society of Laryngeal Surgeons, Rochester, New York, February 11, 1939.
Submitted for publication March 6, 1939.

TABLE I—SMALL DEEP GRAFTS

Graft No	Case No	Age	Location of graft	Diagnosis	Size of grafted area—cm	Donor area	Interval between operation and test	Sweating response	Remarks
1	MA 75668	10	Dorsum of foot	Traumatic wound	6 by 3	Anterior thigh	2 yrs	0	Scar underlying grafts
2	SP 153442	19	Dorsum of foot	Gloria's tumor	5 by 5	Anterior thigh	10 mos	0	Subcutaneous tissue excised
3	EH 46900	40	Dorsum of foot	Abcess of foot	6 by 3	Anterior thigh	6 mos	0	Scar underlying grafts
4	SR 73842	15	Over acrum	Traumatic wound	10 by 14	Anterior thigh	13 mos	0	Subcutaneous tissue avulsed
5	SB 160814	50	Upper arm	Traumatic wound	14 by 12	Anterior thigh	2 yr	0	Scar tissue under graft
6	MP 107690	27	Over sacrum	Fibrosarcoma	6 by 8	Anterior thigh	3 yrs	Slight	No underlying scar tissue
7	PS 162612	15	Over sacrum	Fibrosarcoma	5 by 6	Anterior thigh	2 yrs	0	Underlying scar tissue
8	GO 18248	56	Back of neck	Carbuncle	4 by 5	Anterior thigh	3 yrs	0	Underlying scar tissue
9	SW 99066	22	Lower leg	Compound fracture	6 by 4	Anterior thigh	2 yrs	0	Underlying scar tissue
10	JB 105327	40	Thoracic region	Burn scar	40 by 30	Anterior thigh	2 yrs	0	Underlying scar tissue
11	FG 177793	40	Thigh	Burn scar	10 by 12	Anterior thigh	1 yr	0	Underlying scar tissue
12	MH 109411	14	Leg	Angioma	8 by 6	Anterior thigh	6 mos	0	Subcutaneous tissue excised
13	WS 197647	15	Arm stump	Traumatic wound	5 by 4	Anterior thigh	6 mos	0	Underlying scar tissue
14	JP 21403	69	Back	Carbuncle	10 by 1	Anterior thigh	3 mos	0	Underlying scar tissue
15	CW 125540	34	Dorsum of foot	Abcess	9 by 14	Anterior thigh	1 yr	0	Underlying scar tissue

odilatation which accompanies diaphoresis. Also, it seems likely that grafts which are cut at a level superficial to the sweat glands of the corium, such as the Ollier Thiersch graft, cannot be expected to exhibit the sweating function.

The sweat tests herein reported were made on 15 cases of small deep grafts, 22 Ollier Thiersch grafts, 15 thick split grafts, 15 whole thickness grafts, and 8 pedunculated flaps. The observations are shown in Tables I to V. In all of these the thermoregulatory type of sweating was induced by means of external heat. The sweat tests were carried out according to the technique of Minor. This is as follows:

The part of the body which is to be studied is uniformly painted with the following solution: Iodine (chemically pure), 15 to 20 grams; castor oil, 10 cubic centimeters; absolute alcohol, 100 cubic centimeters.

The skin must be completely dry and clean before this mixture is applied. The solution is non-irritant and innocuous even if the entire body is painted. However, it should not be applied to the eyelids or the external genitalia. After the mixture has dried, the skin has a greasy, dark yellowish appearance. The painted parts are then dusted with fine rice starch powder which readily adheres to the skin. The starch should be lightly pressed into the pores of the skin with the help of a cotton powder puff and

all excess should be fanned away. The skin so prepared has a white or ivory hue. The moisture of the first sweat secreted produces an iodine starch reaction. At first the individual openings of the sweat glands appear as fine, bluish black dots resembling poppy seeds. With increasing perspiration the fine dots enlarge gradually until they join, forming violet black areas. At an advanced stage the excessive moisture drops down and, as it rinses off the mixture of iodine and starch, the pink color of the skin reappears. The skin can be cleaned by washing with soap and water.

RESULTS OF SWEAT FUNCTION TESTS IN DIFFERENT TYPES OF GRAFTS

Small deep grafts. Of the 15 cases reported in Table I only one showed even slight sweating. This occurred in pin point fashion over a few of the larger and thicker grafts on the healed wounds. There was, of course, no sweating at all over the epithelial scar bridging the grafts. In all of these cases the grafts had been placed on granulating surfaces which had been grossly infected. The presence of underlying scar, and the fact that this type of graft is cut in a cone shape so that little of the deeper corium containing sudoriferous glands is included in the graft, explains the absence of sweating in this type of graft.

Ollier Thiersch grafts. Of these 22 grafts, listed in Table II, only 1 showed slight sweat

TABLE II—OLLIER THIERSCH GRAFTS

Graft No.	Case No.	Age	Location of graft	Disease	Size of grafted area—cm	Donor site	Interval between operations—days	Sweating response	Remarks
5	H. H. 73907	1	Dorsal midline	Graveling wound from burn	5 by 5	Anterior thigh	2 yr	Slight	Swelling and excised
12	E. B. 6809	5	Anterior thigh	Cancer of breast	6 by 7	Anterior thigh	2 yr	0	Subcutaneous tissue excised
18	M. B. 60230	60	Anterior thigh	Cancer of breast	5 by 6	Anterior thigh	2 yr	0	Subcutaneous tissue excised
19	J. T. 433	37	Dorsum of foot	Melanoma	5 by 6	Anterior thigh	2 yr	0	Subcutaneous tissue excised
9	E. B. 1276	66	Anterior thigh	Cancer of breast	5 by 5	Anterior thigh	10 mos	0	Subcutaneous tissue excised
	F. M. 684	49	Low eyelid	Basaloid carcinoma	2 by 4	Anterior thigh	2 yrs	0	Subcutaneous tissue excised
	M. D. 84700	35	Anterior thorax	Cancer of breast	6 by 4	Anterior thigh	15 mos	0	Subcutaneous tissue excised
3	J. K. 15375	49	Face	Squamous cell carcinoma	4 by 6	Anterior thigh	2 yrs	0	Subcutaneous tissue excised
4	R. N. 333	50	Anterior thorax	Cancer of breast	2 by 3	Anterior thigh	2 mos	0	Subcutaneous tissue excised
5	W. B. 77823	39	Lower calf	Hemangioma	6 by 5	Anterior thigh	2 yr	0	0
6	H. K. 9847	4	Anterior thigh	Cancer of breast	6 by 4	Anterior thigh	11 mos	0	Subcutaneous tissue excised
7	F. M. 73506	7	None	Basaloid carcinoma	5 by 5	Anterior thigh	1 yr	0	Subcutaneous tissue excised
4	J. N. 436	63	Anterior thorax	Cancer of breast	8 by 6	Anterior thigh	2 mos	0	Subcutaneous tissue excised
9	A. T. 855	5	Dorsum of foot	Melanoma	4 by 6	Anterior thigh	2 yr	0	Subcutaneous tissue excised
5	E. J. 53509	49	Anterior thigh	Cancer of breast	7 by 5	Anterior thigh	9 mos	0	Subcutaneous tissue excised
3	L. B. 5995	4	Anterior thigh	Cancer of breast	7 by 4	Anterior thigh	9 mos	0	Subcutaneous tissue excised
3	E. J. 53507	49	Anterior thigh	Cancer of breast	6 by 4	Anterior thigh	2 yr	0	Subcutaneous tissue excised
33	R. B. 8899	6	Anterior thigh and right	Cancer of right breast	1 by 4	Anterior thigh	2 yr	0	Subcutaneous tissue excised
34	R. B. 8899	46	Anterior thigh and left	Cancer of left breast	5 by 4	Anterior thigh	2 yr	0	Subcutaneous tissue excised
35	C. M. 669	3	Anterior thigh	Cancer of breast	8 by 5	Anterior thigh	2 yr	0	Subcutaneous tissue excised
36	D. P. 1753	30	Anterior thorax	Cancer of breast	8 by 4	Anterior thigh	2 yr	0	Subcutaneous tissue excised
37	C. B. 8977	49	Anterior thigh	Cancer of breast	8 by 5	Anterior thigh	1 yr	0	Subcutaneous tissue excised

ing limited to 2 very small areas. In that case (graft No. 16) all of the subcutaneous tissue had not been destroyed by the burn and underlying scar was minimal. In the 21 other cases (grafts Nos. 17 to 37) all of the subcutaneous tissue had been excised at the time of operation. The total absence of any sudoriparous glands in the grafts or in the underlying tissues explains the absence of the sweating function.

Thick split grafts. Of the 15 grafts of this type listed in Table III only 2 showed any sweating. In 1 case (graft No. 46) the thick split graft was applied to the palm of the hand in the technique of Lotheissen's operation for Dupuytren's contracture. The graft was applied to a clean surface of healthy subcutaneous tissue in a region abundant with sweat glands. In the other case (graft No. 51)

the thick split graft was applied to the surface of a wound in the process of healing after a burn. The subcutaneous tissue and some of the corium had survived the burn. In the 13 other cases (grafts Nos. 38, 39, 40, 41, 42, 43, 44, 45, 47, 48, 49, 50, 52) either the subcutaneous tissue was excised completely at the time of operation or there was evidence of excessive scar underlying the graft. The results of these tests indicate that the thick split graft does not exercise the function of sweating.

Whole thickness grafts. The result of the sweat test in 15 whole thickness grafts (Table IV) shows that all but one had a positive sweating response. In this case (graft No. 59) in which the graft was located on the lower lip hypertrophic scar formation was present around and under the graft elevating

TABLE III—THICK SPLIT GRAFTS

Graft No	Case No	Age	Location of graft	Diagnosis	Size of grafted area—cm	Donor area	Interval between operation and test	Sweating response	Remarks
38	R R. 140574	12	Buttock	Burn scar	12 by 14	Anterior thigh	1 yr	0	Scar tissue underlying graft
39	B H. 86722	20	Anterior thorax	Cancer of breast	8 by 6	Anterior thigh	8 yr	0	Subcutaneous tissue excised
40	W S. 109186	9	Upper arm	Traumatic wound	14 by 9	Anterior thigh	20 mos	0	Subcutaneous tissue excised
41	R P. 40640	38	Anterior thorax	Cancer of breast	8 by 5	Anterior thigh	2 yrs	0	Subcutaneous tissue excised
42	N H. 138322	54	Cheek	Cancer of face	4 by 3	Anterior thigh	20 mos	0	Subcutaneous tissue excised
43	E H. 40600	42	Anterior thorax	Cancer of breast	7 by 4	Anterior thigh	6 mos	0	Subcutaneous tissue excised
44	M D. 182100	52	Dorsum of hand	Traumatic wound	8 by 6	Anterior thigh	5 mos	0	Scar tissue underlying graft
45	E N. 140786	57	Anterior thorax	Cancer of breast	6 by 4	Anterior thigh	2 yr	0	Subcutaneous tissue excised
46	F H. 23200	50	Palm of hand	Dupuytren's contraction	5 by 5	Anterior thigh	21 mo	Slight	Sweating limited to one area 1 cm square
47	E M. 103643	48	Anterior thorax	Cancer of breast	6 by 6	Anterior thigh	10 mos	0	Subcutaneous tissue excised
48	V R. 42331	52	Anterior thorax	Cancer of breast	9 by 5	Anterior thigh	1 yr	0	Subcutaneous tissue excised
49	M G. 112093	35	Eyelid	Traumatic ectropion	2 by 2	Anterior thigh	6 mos	0	
50	M T. 125118	40	Upper arm	Lipoma of arm	6 by 6	Anterior thigh	9 mos	0	Subcutaneous tissue excised
51	N L. 70045	29	Anterior thorax	Burn scar	6 by 4	Anterior thigh	14 mos	Slight	Sweating limited to one area 1 cm square
52	A S. 24743	40	Anterior thorax	Cancer of breast	6 by 4	Anterior thigh	16 mos	0	Subcutaneous tissue excised

TABLE IV—WHOLE THICKNESS GRAFTS

Graft No	Case No	Age	Location of graft	Diagnosis	Size of grafted area—cm	Donor area	Interval between operation and test	Sweating response	Remarks
53	M O. 155593	64	Lower eyelid	Cancer of eyelid	1 by 2	Upper eyelid	6 mos	Slight	Subcutaneous tissue excised
54	H M. 123708	21	Cheek	Mole	2 by 2	Postauricular area	6 mos	+	
55	A B. 70133	5	Ulnar side of palm	Cancer of hand	3 by 3	Inner aspect upper arm	1 yr	Slight	Subcutaneous tissue excised
56	J A. 176680	27	Cheek	Burn scar	3 by 3	Postauricular area	6 mos	Slight	Scar underlying graft
57	H M. 109954	11	Lower eyelid	Ectropion burn scar	3 by 3	Postauricular area	7 mos	Slight	
58	J D. 12443	22	Lower eyelid	Ectropion burn scar	3 by 3	Upper eyelid	10 mos	+	
59	E B. 170400	14	Lower lip	Hairy mole	3 by 3	Postauricular area	1 yr	0	Hypertrophic scar under graft
60	R G. 206037	5	Upper arm	Hairy mole	8 by 10	Abdomen	9 mos	+	
61	C M. 120042	2	Finger	Congenital contracture	3 by 2	Abdomen	9 mos	+	
62	M F. 123206	43	Finger	Contracture	4 by 5	Inner arm	1 yr	++	
63	A R. 123762	10	Eye lid	Ectropion	3 by 2	Postauricular area	1 yr	+	
64	F G. 182097	27	Thigh	Burn scar	20 by 8	Lumbar region	10 mos	+	
65	M C. 28343	23	Groin	Burn scar	11 by 4	Lumbar region	1 yr	+	
66	H H. 15997	27	Groin	Burn scar	12 by 7	Lumbar region	2 yr	+	
67	S L. 119004	75	Temporal region	Melanoma	5 by 5	Abdomen	6 mos	Slight	Subcutaneous tissue excised

TABLE V—PEDUNCULATED FLAPS

Graft No.	Cs. No.	Age	Location of graft	Diagnosis	Size of grafted area—cm.	D. r. area	Interval between period of test	Sweating response	Remarks
68	III 73067	0	El or ulf e of wrist	B. sca	8 by 5	Abdomen	2 yrs	+	
69	JR	2	Chest	Traumatic ca	7 by 7	Anterior chest	2 yrs	+	
	M.L. 5145	6	Palms	B. n. car	7 by 6	Abdomen	2 yrs	+	
7	P.C. 45 25	9	Anterior knee	B. a	8 by 10	Lumbar region	10 mos	+	
	G.C. 10	10	Upper arm	Amputation?	9 by 5	Thoracic region	mos	+	
8	II L 48 54	52	Upper lip	Cancer of lip	3 by 6	Cheek region	1 mos	+	
4	FIH 5437	62	Ear	Metastasis	3 by 6	Cervical region	3 mos	Slight	Flap contained cartilage
5	P. 41512	4	Wrist	Carcinoma	6 by 10	Abdomen	1 mos	Slight	

it above the surface of the skin and giving to it the appearance of a keloid although the graft itself had survived completely. This underlying scar probably interfered with the development of the hyperemia associated with sweating. In the case which exhibited a marked degree of sweating the graft had been taken from the inner aspect of the arm near the axilla, an area abundantly supplied with sweat glands. The results of these tests are in keeping with expectation based on a study of the microscopic anatomy of the skin, for the reason that sweat glands are known to be present not only in the subcutaneous tissue but also in the corium many of them being transplanted with the whole thickness type of skin graft.

Pedunculated flaps. In all of these 8 cases some degree of sweating was evidenced. The transplantation of a block of skin with its subcutaneous tissue leaves the sweat glands of the transplant undisturbed except, of course, for the fact that the nerves and blood vessels to the area must be reestablished. In this series of observations no adequate information has been gained as to how soon after transplantation of skin and subcutaneous tissue by means of a pedunculated flap, the sweating function is reestablished, nor can inference be drawn as to whether or not the reestablishment of the sweating function must be preceded by the regeneration of sympathetic nerves to the skin. It is known that the sweat glands of the skin are abundantly supplied with capillary vessels and small non-

medullated nerves which form plexuses about the walls of the coiled portion of the gland and from which terminal fibrils penetrate the basement membrane to end in contact with the secreting cells. The earliest time that sweating was observed in this series (graft No. 7) was 3 months. This graft was located on the wrist of the patient. Since it has been observed that sensation to pain may return completely as early as 63 days after transplantation of tissue by means of a pedunculated flap, it is possible that the regeneration of the regional sympathetic nerves is a necessary part of the re-establishment of the sweating function of the flap.

SUMMARY AND CONCLUSIONS

The results of a study of the sweating function of transplanted skin are reported. Of the 75 grafts studied, whole thickness grafts and those transplanted by means of pedunculated flaps were found to be capable of sweating while small, deep, Ollier Thiersch and thick split grafts were not.

The age of the individual apparently is not an influencing factor.

The findings indicate that the re-establishment of the sweating function of the skin depends certainly upon the presence of sudoriferous glands in the transplant.

This study gives no information on the question as to whether or not the sympathetic nerve fibers to the grafts of skin must be reestablished before the sweating function can take place.

BIBLIOGRAPHY

- 1 DAVIS J S and KITLOWSKI E A Regeneration of nerves in skin grafts and skin flaps Am J Sur, 1934 24 501
- 2 DAVIS LOYAL The return of sensation to transplanted skin Surg, Gynec & Obst 1934 59 533
- 3 GUTTMAN I Re establishment of function of sweat glands etc Dermat Ztschr 1938 77 73-77
- 4 KROFFT I I, and EVANS J I Recovery of sensation in denervated pedicle and free skin grafts Arch Neurol & Psychiat 1933 29 1203
- 5 MCCARROLL H R The regeneration of sensation in transplanted skin Ann Surg 1938 108 300
- 6 MINOR V Ein neues Verfahren zu der klinischen Untersuchung der Schweissabsonderung Deutsche Ztschr f Nervenhe 1927 101 302



ACETYLCHOLINE AS A DIAGNOSTIC TEST IN CASES OF CONGENITAL MEGACOLON

GÉZA DE TAKATS M.D. F.A.C.S. Chicago, Illinois

THE success of sympathectomy for congenital megacolon depends on the extent of the lesion and the state of the colonic musculature. In a study of 10 patients (2) it was found that while some show marked muscular hypertrophy others come to autopsy or are seen during laparotomy with extreme thinning out of the colonic wall and a complete loss of musculature.

From the Department of Surgery, University of Illinois College of Medicine and St. Luke's Hospital.

Whether this is a congenital defect a result of exhaustion and muscular decompensation or the nutritional effect of constant distention is difficult to say. But the fact remains that when the muscular power of the colon is lost no type of sympathectomy can help. Morton and Scott have made an important contribution to the subject. They proposed the use of spinal anesthesia to inhibit the sympathetic outflow to the colon and demonstrated the evacuation of the colon under the anesthetic.



Fig. 1. Case of Eugene W., 7 year old boy suffering from congenital megacolon. Barium enema obtained after 3 weeks of preparation of the colon with large warm enemas and 2 daily injections of acetylcholine. The colon filled slowly. The rectum and sigmoid are markedly dilated. The sigmoid loop is displaced into the right upper quadrant. There is a sharp kink at the highest point and the diameter of the proximal loop is not increased. The rest of the colon has filled as far as the middle third of the transverse colon. It is freely movable and looks normal.



Fig. 2. Same colon as in Figure 1, 45 minutes after the administration of 0.7 cubic centimeters of acetylcholine bromide subcutaneously. The large bowel contracted markedly and there is a definite evacuation. The mucosal pattern of the sigmoid loop is bizarre, the mucosa having the appearance of that of the upper gastro-intestinal tract. Sympathectomy resulted in daily bowel movements without drugs or cathartics.

Spinal anesthesia has been used in some of our earlier cases of megacolon as a pre operative test. In these anxious, undernourished, poorly disciplined children a spinal anesthesia is not always easy to perform. In 3 of our last cases we resorted to stimulating the pelvic parasympathetic outflow instead of inhibiting the sympathetics. A three fourths ampule of acetylcholine bromide in children or one whole ampule in adults produces a prompt evacuation of the barium, if muscular power is available. One ampule contains 0.1 gram of the drug. Ten milligrams of mecholyl are equally useful. One patient with a poor response showed a thin transparent membrane instead of a hypertrophied colon.

Following the slow instillation of barium, diluted with equal amounts of petrolagar, the first film is taken (Fig 1). Forty five minutes after the subcutaneous injection of acetyl-

choline a second film is obtained (Fig 2). The drug is useful for evacuating the residual barium and for preparing the colon for operation. It has been used for periods from a week to 10 days, twice a day, without any untoward effects.

The drug is equally helpful in the treatment of postoperative, paralytic ileus as advocated by Abel. An ampule may be given every 6 hours until gas is passed or the bowels have acted without an enema.

It is a pleasure to thank Dr. E. L. Jenkinson for the facilities of the X-ray Department.

REFERENCES

1. ABEL, L. Acetylcholine in paralytic ileus. *Lancet* 1933, *1*: 47.
2. DE TAKATS, G. and BIGGS, A. D. Observations on congenital megacolon. *J. Pediat.* 1938, *13*: 819.
3. MORTON, J. J. and SCOTT, W. J. M. Studies on the activity of the lumbar sympathetic nervous system. *Ann. Surg.* 1930, *92*: 919.

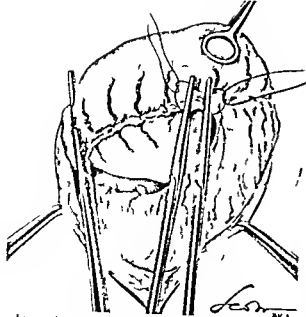


Fig 3 Gastroepiploic vessels ligated and greater omentum incised along greater curvature

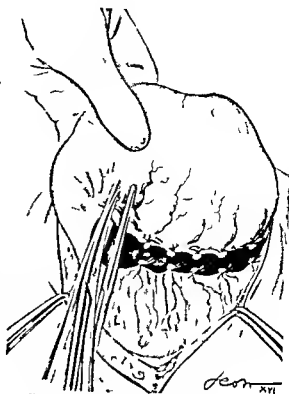


Fig 5 Omentum incised along lesser curvature

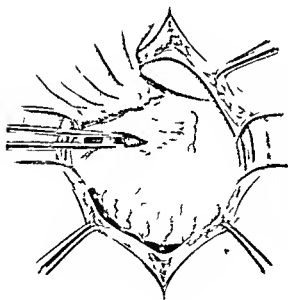


Fig 4 Opening of lesser omentum

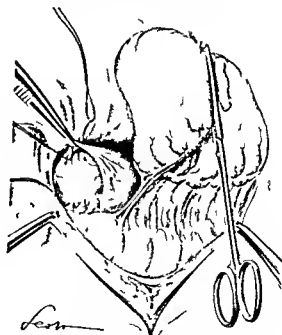


Fig 6 Incision of duodenum

Technique of Gastric Resection for Gastroduodenal Ulcer — Roberto Alessandri

CLINICAL SURGERY

FROM THE *R. CLINICA CHIRURGICA*

TECHNIQUE OF GASTRIC RESECTION FOR GASTRODUODENAL ULCER

ROBERTO ALESSANDRI, M D, Rome, Italy

IN preparation for the operation under discussion the patient is made to rest in bed for 2 days, and an accurate examination of renal and cardiac functions is performed. Patients with disturbances of the respiratory apparatus are not considered in condition for operation until all signs of bronchial catarrh have disappeared. We have abandoned the use of all vaccines against eventual postoperative complications inasmuch as our experience has convinced us that preventive vaccination is useless. Thorough cleansing of the teeth, the elimination of dental caries, and the extraction of decayed roots are all essential details in preoperative preparation.

In the days preceding operation patients are placed on a light diet, essentially of carbohydrates. The night before the operation an enema is given, we never give a cathartic to our patients. In the presence of pyloric stenosis, we do 2 gastric lavages a day on the days preceding the operation. We have observed that by so doing the stenosis is generally diminished, probably because the muscular wall of the stomach, which is no longer distended picks up in tone and contractile power.

The operation is usually performed under local anesthesia preceded by basal anesthesia. We have used, with good results both "preanest. Zambelletti" and the "dilaudid scopolamine, Knoll." These substances are first injected $1\frac{1}{2}$ hours before operation and again a half hour before. Usually camphor or a digitalis compound is also injected. In patients with pyloric stenosis, in those who are generally depressed, or in very old patients a half or three quarters of a dose is sufficient to obtain the required results. The patient is placed on the operating table with a pillow under the base of the thorax so as to render the deep organs more accessible.

Anesthesia is produced by infiltrating systematically the skin, the subcutaneous tissue, and the

peritoneal fat along the linea alba. Besides local anesthesia we use regional anesthesia which is secured by injecting the anesthetic into the sheath of the rectus muscle and into the subcutaneous tissue at a distance of 3 to 4 centimeters from the linea alba. We use a 0.5 per cent solution of novocain or a 0.2 per cent solution of tutocaine about 120 to 150 cubic centimeters are sufficient.

Incision. The incision is xiphoid-umbilical and rarely prolonged below the umbilicus (Fig. 1). Having provided for hemostasis we fix the peritoneum to the towels so as to exclude the subcutaneous tissue and the skin from contact with the viscera.

Exploration should always be accurate, and the lesser curvature should always be exam-

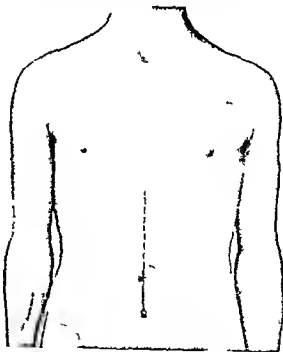


Fig. 1. Incision of the abdominal wall.

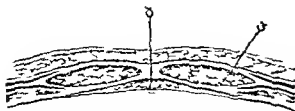


Fig. 2 Anesthesia along linea alba and rectus muscle sheath

ined even when a duodenal lesion is immediately evident. We always perform resection thus attempting to remove the duodenal ulcer. We have noticed even in cases of deep ulcers penetrating into the surrounding organs, that it has been possible to remove the ulcer completely with accurate resection. Only in rare cases in which the general condition (age and weakness) was very poor have we abandoned the use of resection.

In the last few years we have performed radical resection in 90 per cent of the cases. In those patients in whom the ulcer is particularly deep we prefer to perform gastro-enterostomy rather than the palliative resection proposed by Finsterlin. However I am convinced that with accurate dissection it is possible to free and remove ulcers which at first might appear to present unsurmountable difficulties.

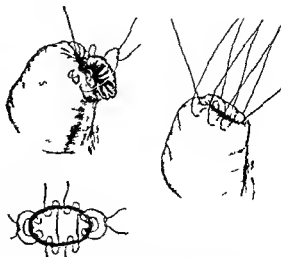


Fig. 7 Closing and peritonization of duodenum

The limits of resection are bounded on the left by the outlet of the left gastric vein on the lesser curvature and on the greater curvature at a point corresponding to the direction of the blood vessels. With a Kocher forceps at this point along the greater curvature the gastro-epiploic ligament is opened and the left gastro-epiploic vein is clamped near the greater curvature. After having applied another hemostatic clamp in a chosen place the blood vessel is cut. Then a finger is introduced across the epiploic opening into the posterior omental cavity (Fig. 5) more hemo-



Figs. 8 and 9 Transverse colon Opening of mesocolon

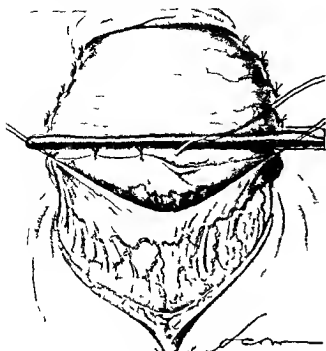


Fig 10 Fixing mesocolon to posterior gastric wall

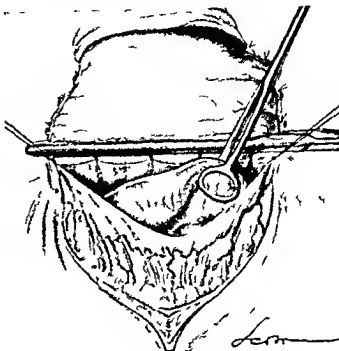


Fig 11 Jejunum coming through mesocolon opening

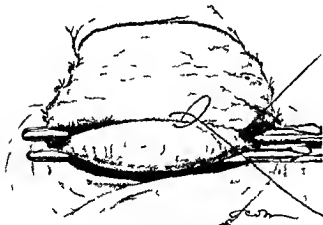


Fig 12 Anastomosis by continuous silk sutures

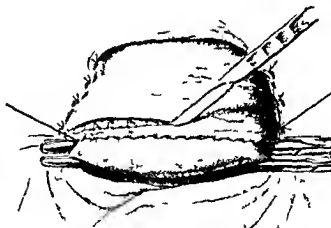


Fig 13 Cutting the seromuscular layer

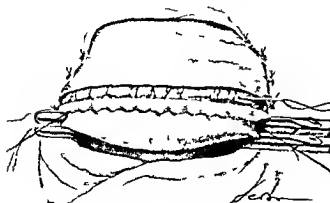


Fig 14 Seromuscular layer severed

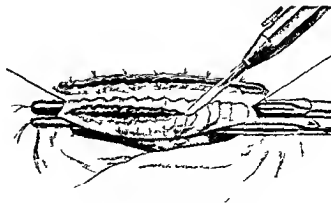


Fig 15 Cutting the mucosa with electric knife



Fig 16 Continuous suture in process

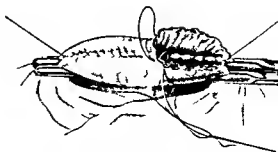


Fig 17 Suturing anterior wall of stomach and intestine

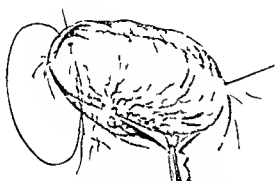


Fig 18 Seromuscular suture

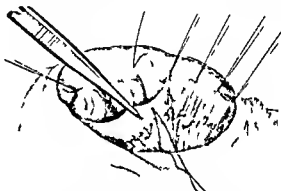


Fig 19 Closing mesocolic opening to complete operation

static clamps are applied to the vessels which leave the gastro-epiploic vein and go to the colic insertion of the omentum. Generally with 3 or 6 consecutive clampings the greater curvature is completely freed. Following this the severed blood vessels of the greater omentum are ligated. Eventual adhesions between the posterior surface of the stomach and the mesocolon are removed. Then introducing a finger behind the stomach the lesser omentum is pierced in an avascular zone (Fig 4). Proceeding from this point the lesser curvature is lifted thereby putting tension on the lesser omentum as has been described previously for the greater curvature and the lesser curvature is isolated as far as the right gastric artery which is cut (Fig 5).

We then proceed to free the duodenum. This is always begun from the outer surface below the ulcer in a direction toward the pylorus never away from it. The ulcer frequently penetrates into the hepatoduodenal ligament and the latter is freed by cutting into the infiltrated ligament always keeping near the ulcer. In this way a possible lesion of the common bile duct is avoided. The freeing of the posterior wall of the duodenum

always below the ulcer proceeds from the duodenum toward the pylorus.

Having thus freed the ulcer and without applying an intestinal clamp we resect the duodenum with scissors at the inferior margin of the ulcer and fold the stomach toward the left. The duodenum is sutured with separate stitches of No 0 catgut according to Connell's method starting from the superior angle. A second series of individual silk stitches is applied and finally provision is made for peritonization by uniting with silk stitches the free margin of the peritoneum that invests the pancreas where it was severed by the dissection of the duodenum and the external surface of the duodenum (Fig 6).

Across a breach in the mesocolon obtained as described the first loop of the jejunum is found and exposed (Figs 8-11). The left margin of the mesocolic breach is fixed with silk stitches to the posterior surface of the stomach from the greater to the lesser curvature at the point where the left gastric artery was ligated. The use of intestinal and stomach clamps is not indispensable. The anastomosis is done in a double line and precisely with a continuous seromuscular suture in silk (Fig 12).

Having completed the posterior line of suture, the muscular layer of the posterior surface of the stomach is cut so as to expose the blood vessels of the submucous stratum (Figs 13, 14). With individual stitches of catgut the greater blood vessels are ligated along the posterior surface. With the electric knife the mucosa of the stomach is cut and immediately after the jejunum is opened and a total continuous suture is made (Figs 15, 16).

After the suture has been completed the stomach is unfolded toward the right and the muscular layer is cut along the anterior surface, followed by hemostasis of the blood vessels of the submucous stratum by means of individual stitches. By cutting the mucosa the portion of the stomach resected will be free (Fig 17).

The complete anterior suture is done by inverting stitches in a manner similar to that used for the posterior suture, that is, by first piercing the mucosa crossing the 2 muscular layers and coming out through the mucosa, looping the stitch after the needle has come out.

Finally, the anterior seromuscular suture is done as a continuous suture (Fig 18). The jejunum is replaced across the opening in the retro mesocolic space, and the right margin of the mesocolic breach to the anterior gastric wall is sutured at about a centimeter above the gastro-intestinal anastomosis (Fig 19). The different layers of the abdominal wall are then sutured.

Postoperative treatment. After the operation the patient is directly transferred from the operating table to his own bed which has been brought to the operating room. He is placed in a sitting posture and in a few hours rectoclysis is begun.

The night after operation morphine and cardio-

tomics are given. The following morning gastric lavage is performed. This is done with a Fremont tube, and a luke warm 2 per cent solution of bicarbonate of soda, in this way a certain amount of bloody and ill smelling gastric residue is removed. After this the patient can take a few sips of water. Night gastric lavage is repeated. Generally 2 such lavages are sufficient. However, if there still remains a great amount of residue, further lavages can be done in the days following.

To prevent postoperative complications we have the patients inhale carbon dioxide. A liquid diet is given for the first 5 days, milk is permitted on the third day, on the sixth day broths, soups, and cooked fruit are given. The patient is allowed to get up on the tenth day.

Postoperative complications. The most frequent complication is gastric stasis which sometimes lasts until the fifth or sixth day. Respiratory complications are frequent but not serious and I believe that they are of an atelectatic nature rather than bronchopneumonia lesions, because, granted that the physical signs speak for bronchopneumonia, the rapid course of the condition and the rise in temperature point to an atelectatic lesion.

If hemostasis of the blood vessels of the gastric mucosa has been properly done the danger of hemorrhage can be completely avoided. We use blood transfusions ranging from 400 to 500 grams in long suffering patients and in those in poor physical condition in order to prevent and eventually ward off operative shock. Peritoneal complications are rare. The possibility of sutures giving way is exceptional. The death rate, which is 2-3 per cent, is due almost wholly to respiratory complications.



Fig 1 a left Left shoulder girdle of a normal middle aged male arm hanging loosely at side b Same shoulder as in Figure 1a X ray tube, film, and spine were unchanged while shoulder has been actively shrugged Observe the striking degree of normal elevation of the outer end of the

clavicle permitting it almost to parallel the spine Thus elevation centers at the sternoclavicular joint Observe that scapular movement has also centered upon both the sternoclavicular and acromioclavicular joints and not through the anatomical center of the bone

body When the shoulder is shifted anteriorly, however, it moves away from the midline until the two clavicular joints are in the same frontal plane Further forward movement will then cause the shoulder to move inward again

3 *Rotation of the clavicle* The clavicle will rotate in its long axis frequently to a degree permitting the inferior surface to look almost directly anterior (Figs 3a, b, and c) Rotatory displacement in clavicular fractures may be especially accentuated by swinging the arm and shoulder forward and upward If fractures of the clavicle are being treated in bed by suspension of the arm in such a position, roentgenograms should be inspected for the presence of this type of displacement

4 *Rotation of the scapula* It is widely believed that in the act of fully abducting the arm, the scapula remains motionless during the first 90 degrees and begins to rotate only when arm abduction is continued above this level However, in most individuals scapular rotation takes place throughout the whole of arm abduction, approximately one third occurring during the first 90 degrees of arm abduction, the remaining two thirds taking place as arm abduction is completed (Figs 3a, b, and c) The resisting influence of muscles and ligaments about the shoulder girdle alter this degree and rate of scapular rotation in different individuals

With fractures of the clavicle each fragment can be displaced with its respective joint as an axis If fragments are to be successfully replaced by an

ambulatory apparatus, points of motion and adjustment *must coincide functionally* with the centers of displacement, namely, the sternoclavicular and acromioclavicular joints



Fig 2 Roentgenograms of a normal adult shoulder demonstrating the long range of anteroposterior movement of the outer end of the clavicle The x ray tube was placed in the axilla with the arm normally abducted lateralward to 90 degrees A wire was extended out from the base of the neck over the center of the shoulder at right angles to the spine and parallel to the frontal plane The film was placed over the top of the shoulder Tube wire and film were held in identical positions only the shoulder moving The letters on the films indicate the direction in which the shoulder was moved This movement also centers at the sternoclavicular joint The outer end of the clavicle in the neutral position is shown in a As the shoulder is shifted posteriorly in b the outer end of the clavicle rapidly comes to lie nearer the midline of the spine Anterior shifting at c on the other hand causes the shoulder to move away from the midline until the two ends of the clavicle lie in the same frontal plane



Fig 3 Shoulder of a normal young male adult. With the x ray tube and film unchanged the arm has been progressively abducted lateralward in the plane of least resistance. Observe that as the position changes the clavicle rotates in its long axis sufficient to permit the inferior surface to look almost directly forward. Also note that over one third of the movement of the scapula has taken

place during the first 90 degrees of arm abduction. The remarkable ability of the head of the humerus to glide out of the glenoid fossa in this normal and uninjured shoulder demonstrates the fundamental importance of soft tissues in maintaining shoulder joint stability. Variable elasticity of the soft tissues will directly alter but only moderately the degree and range of normal shoulder girdle movement.

PRINCIPLES OF TREATMENT

Most fractures of the clavicle result from force transmitted through the abducted arm to the clavicle or from a blow directed against the shoulder itself. The fracture line is usually oblique with the common site of break in the middle third of the bone where the two normal curves meet. The usual deformity, namely, that of the shoulder with attached outer fragment falling downward and inward, has long been well understood.

The significant elements involved in reduction of the fractured clavicle consist of upward, outward, and backward replacement of the shoulder (Figs 4a and b). Scores of methods have been used to accomplish this treatment.

Key and Conwell aptly state the situation as follows:

"—more than 200 different methods have been described and recommended for the treatment of fractures of the clavicle. This is of course evidence that we have no method which is satisfactory to the majority of surgeons. The displacement can be reduced by simply pulling the shoulder backward, outward, and upward, but this reduction is almost impossible to maintain in an ambulatory patient because any form of dressing or apparatus which maintains anatomic reduction will be intolerant to the patient."

Clinical experience has incontrovertibly convinced us that the basic maneuver for successful reduction is elevation, and that when adequate elevation of the shoulder is sustained, the fragments will be fixed, yet the arm may be freely and painlessly moved without disturbing the fracture site. Displacing the shoulder far posteriorly, the basic idea of many of the current treatments, is not so necessary when a practical method of supplying the desired degree of elevation is provided. In fact, with an accurate physiological means for immobilizing the shoulder girdle in any desired position, one is more and more impressed with the fact that frequently the best reductions will be had by merely replacing the outer fragment up to or slightly above the normal neutral position.

Shortening the distressful factor with most fractures, is doubly difficult to maintain corrected in the clavicle because not only strong muscle contraction but the pull of gravity on the arm must be overcome. Experience with extremity fractures has proved that the effectiveness of the traction varies directly with the coincidence of the line of pull to that of the extremity. A successful treatment must therefore be one that exerts traction in direct line with the long axis of the clavicle. By the elevation of the shoulder in the normal sagittal body plane, traction on the

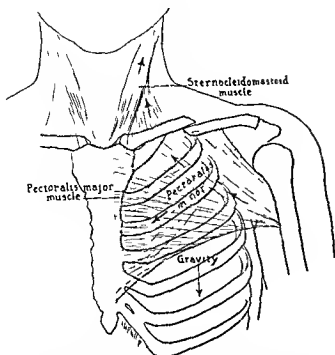
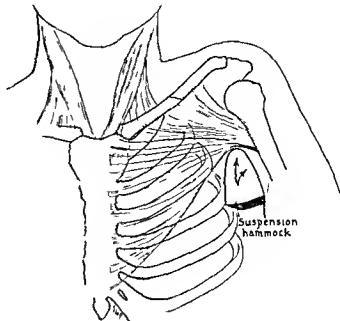


Fig 4 a left Diagrammatic illustration of the common deformity following fracture of the clavicle with the displacing forces shown b Reduction obtained by suspending a suitable hammock in the axilla and elevating the

clavicle along its long axis is accomplished Skeletal transfixion of the outer end of the clavicle or the acromion process, a means of obtaining traction used by some surgeons, will rarely be necessary when adequate sustained elevation of the shoulder is available

Optimal treatment requires (1) anatomical reduction (2) efficient and painless immobilization (3) immediate ambulation, and (4) relatively free use of both arms Since elevation provides the principal mechanism whereby the fracture can be reduced and held the problem resolves itself chiefly into a means of securing and maintaining proper elevation

Fig 5 Suspension hammock clavicle splint a and a Strap under well shoulder b and b Strap over well shoulder c and c d and d Straps crossing around lateral body wall e Rubber axillary hammock f Joint at shoulder where hammock attaches to frame of splint g Bolt at shoulder adjustment i Sternoclavicular adjustment which controls sliding bars j and j Anterior and posterior chest plates padded with sponge rubber k and k Anterior and posterior bars l Lateral body plate The sliding bars k k control the position of the hammock By elevating them the shoulder is elevated by sliding them both laterally the shoulder is displaced outward by sliding the anterior bar laterally and bringing the posterior bar medially, the shoulder is displaced backward The splint is made in 3 sizes child medium and large Since both sides are identical it is completely reversible and fits either side of the body without a single change yet operates at all times on anatomical centers



shoulder The pull of gravity previously a displacing factor is now favorably utilized to supply lateral traction This action on the outer fragment further assists in correction of shortening

SUSPENSION ELEVATION

Obviously, the bony shoulder girdle is normally elevated by a lifting rather than a pushing mechanism Contraction of the sternocleidomastoid,

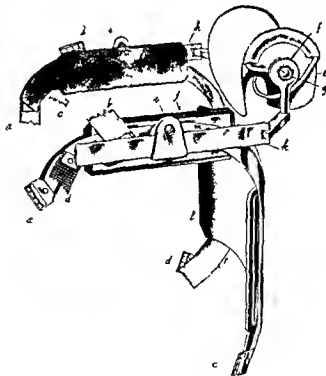


Fig 5



FIG 6 Mrs N G a left Comminuted fracture through middle third of the left clavicle in a middle aged woman. Fractures of the clavicle in adults are frequently comminuted with one or more loose fragments. b Same patient as in Figure 6a following immediate reduction in suspension

hammock splint. The outer fragment and shoulder have been elevated into a position producing correct alignment. Control and fixation of the shoulder from the anatomical center of the sternoclavicular joint makes possible this type of reduction.

trapezius levator scapulae and rhomboid minor muscles shortens the distance between the upper spine and shoulder. With the head and spine fixed these muscles lift the shoulder upward. The physiologically correct means for securing shoulder elevation in clavicular fractures should utilize this same lifting mechanism. With the patient in bed, suspension-elevation can be accomplished by adhesive or flannel traction on the shoulder. In the past there has been no means whereby the same principles could be utilized and still permit ambulation. This can be accomplished however by suspending a resilient compressible hammock under the axilla and elevating this hammock. Such suspension-elevation to conform to anatomical lines must be functionally adjustable from centers over the clavicular joints.

SUSPENSION HAMMOCK SPLINT

To apply the principle of suspension elevation successfully we use a new type of clavicular splint. With this appliance it is possible to treat fractures of the clavicle along correct anatomical and physiological lines at the same time allowing the patient to be up and about wearing usual clothing and retaining use of both arms. Convalescence is painless, the splint is comfortable. Many patients return to work a few days after injury. In fact skilled and professional workers have continued work regularly with splint in place.

The splint (Fig 5) consists of (1) a body frame or base and (2) a rubber suspension axillary hammock. The base fits comfortably and snugly to the patient, and from the anterior and posterior

chest plates two sliding bars extend laterally supporting the axillary hammock. These bars are completely adjustable from a point over the sternoclavicular joint hence correct replacement of the shoulder to any desired position is accomplished along the normal axis. The design of the base is such that the weight of the injured shoulder girdle is largely borne by the well shoulder and upper relatively immobile portion of the chest and back. In this way undue constriction to respiratory movement is avoided and the support is more constant and stable than that derived from lower down on the chest or from the pelvis.

The hammock is molded to conform to the axilla. Its special rubber composition distributes the weight over a large surface thus avoiding axillary compression. Thus not only adequate elevation so essential for immobilization can be obtained and held but also both backward and lateral replacement is available when needed.

APPLICATION OF THE SPLINT

No anesthesia is necessary in most cases. However if the patient is unduly apprehensive or suffering a good deal of pain a local injection of 2 per cent procaine at the fracture site allows painless placement of the splint and reduction of the fracture. Being superficial the fracture site is easily located and injection of as little as 3 to 5 cubic centimeters of procaine into the hematoma will usually allow painless manipulation.

With the patient sitting or standing the splint hammock attached is fitted to the patient with the adjustment on the anterior chest plate lying



Fig 7 Mr G D a, Transverse fracture through the middle third of the right clavicle in an adolescent boy. This type of fracture usually displaced is commonly seen in children and adolescents. b Reduced under local anesthesia with suspension hammock splint. c Three days after reduction. Normal clothing is comfortably worn. The reduced position of fragments is maintained despite comparatively free use of arm. Elevation and slight posterior position of shoulder on injured side are clearly seen.

near the sternoclavicular joint. It is well to pad all parts of the splint contacting the skin, preferably with cotton gauze pads. The 4 straps attached to the body base hold it firmly in place, 1 strap going over the well shoulder, 1 under the well arm and the 2 long straps crossing loosely around the body to attach to the extensions below the lateral body plate. The well shoulder and axillary straps are really the fundamental fixateurs. The 2 long straps merely assist in stabilizing the lateral body plate, should the appliance be converted into an airplane splint. Reduction is accomplished by loosening the two bolts controlling the sliding bars and placing shoulder in correct position.

As was stated, elevation will be the basic

maneuver. Sufficient elevation should be obtained yet it is possible to overelevate the shoulder. Before any patient wearing the splint is discharged, positive roentgenographic and physical evidence of bony contact must be obtained. If necessary to place the shoulder posteriorly, the anterior sliding bar is lengthened and the posterior bar shortened. Lateral replacement is obtained by sliding both bars outward. As the arm falls outward over the hammock, the pull of its weight will further assist in correcting overriding.

With the desired position attained, the adjustment bolts are firmly fixed and the patient is free to wear regular clothing, continue normal activity, and enjoy the use of the arm. Because the weight



Fig. 8. Mr. L. K. a. Spiral fracture of the outer third of the left clavicle in a young male adult. This is a third type of clavicular fracture commonly encountered. The patient is wearing a crutch splint of the standard type. Despite the fact that the splint was fitted but the day before the displacement has reappeared. b. End result of fracture shown in Figure 8 a. Patient was placed in a suspension hammock splint and the shoulder adequately controlled. Note the

satisfactory alignment with restoration of length. Although the type of fracture determines to a certain degree the amount of callus thrown out, correct reposition of fragments maintained throughout healing minimizes excessive callus production and subsequent deformity. c. Patient wearing the suspension hammock splint 3 weeks after injury. In many cases patients are able to return to certain types of work during convalescence.

of the shoulder is transmitted through the splint to the body along the anatomical lines, there is no tendency for the splint to slide downward, hence the position is not lost. Adjustments, therefore, are infrequently needed.

The splint is left in place continuously for 3 weeks or more as indicated by type of fracture and

rate of healing. Check up roentgenograms are taken at intervals and any adjustments made.

The immobilizing treatment of the fractured clavicle is the same whether it be comminuted, spiral, transverse or compound. A greenstick fracture with marked angulation calls first for manual correction. The technique, moreover, permits alterations and additions to fit the case.

If skeletal transfixion of the outer fragment is desired, the splint affords an excellent means of both traction and countertraction; the transfixion being fastened to rods supporting the hammock.

Burgess arm attachments can be used to convert the clavicle splint into a completely adjustable airplane splint for the treatment of scapular and arm injuries as well as fractures of the clavicle, thus retaining and utilizing the physiological principles in ambulatory treatment of practically all pathology in the shoulder area.

Specifically, we use the base of this splint with attachments for (1) fractures of clavicle, (2) acromioclavicular dislocations, (3) fractures of scapula, (4) fracture dislocations of shoulder, (5) fractures of upper end of humerus, and (6) arthritis, peri-arthritis, and soft tissue injuries in shoulder area. In the rare non union of the clavicle that demands operative treatment, the splint can be used after operation, since internal fixation alone is usually insufficient.

Recapitulating the steps in reduction, they are as follows: (1) Select suitable size splint (child, medium, large). (2) Pad and fit splint to patient. (3) Reduce fracture, this being accomplished largely through elevation of shoulder in normal sagittal plane, and (4) check position with x-ray.

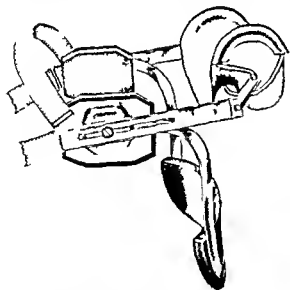


Fig. 9. A modified splint economically designed to treat fractures of the clavicle alone. The fundamental principle of suspension elevation is retained with controlled adjustment anatomically centered over the sternoclavicular joint. The low construction cost permits its use in large charity clinics.



Fig 10

Fig 11

Fig 12

Fig 13

Fig. 10 Miss F B Fracture outer third of the left clavicle. Good bony union without deformity despite fact patient returned to work with splint on as a saxophonist in a dance orchestra. Observe compactness of splint freedom of breasts lower chest and arms and elevation of shoulder. The ease of obtaining and maintaining elevation by this method necessitates a caution against overelevation.

Fig 11 Child size splint. Since only the molded compressible rubber hammock supports the axilla elevation of the shoulder is well tolerated. Although unable to loosen the hammock rocks freely, thus conforming to axillary contour at all times.

Fig 12 Mr A L Compression fracture of the first

lumbar vertebra and comminuted fracture of the outer third of the left clavicle. A hyperextension plaster jacket was applied after which a suspension hammock splint was placed on the plaster. The splint is an earlier model. When his general condition permitted patient was ambulatory wore usual clothing and returned home.

Fig 13 Mr R H Left acromioclavicular dislocation 3 days after injury. Patient is wearing the regular suspension hammock clavicle splint with a strap over the injured clavicle to hold it firmly down in normal position. This case was immobilized as illustrated in Figure 14 but many of the complete dislocations are better controlled with the arm in wide abduction (Fig 15). The suitcase is empty

MISTAKES IN TREATMENT

This method of treatment is not foolproof. The physician must treat each case with a clear cut understanding of the exact mechanical objective desired. Hurried reductions and neglected after care have no place in the treatment. Mistakes occasionally seen are (1) use of wrong size splint, (2) improper placing of the splint, (3) inadequate padding under plates and straps, (4) overelevation of the shoulder—fracture ends must contact at all times, (5) attempt to push the shoulder too far lateralward—surprisingly little if any lateral push is necessary, (6) neglect of patient in reporting frequently for examination, (7) failure to take repeated check-up roentgenograms, and (8) removal of splint before there is good bony union.

A disadvantage with this method is the need of special equipment. Despite the achievement of superior results and the satisfaction of having an appreciative patient, the added expense will tend

to limit the field of usefulness of any treatment requiring individual apparatus. Faced with this problem, we have designed an inexpensive, simple modification of the original splint to fulfill accurately all the requirements of suspension elevation, yet modest enough in construction cost to be used on clinic and charity hospital cases (Fig 9).

ADVANTAGES

With this new approach to treatment, fractures of the clavicle can be both accurately reduced and comfortably immobilized with a minimum of time loss or expense to either patient or physician. Because the principle of suspension elevation controlled from the sternoclavicular joint is fundamentally correct, maximum results can be expected. Sustained reduction, unavailable with most standard ambulant methods, is a significant feature of this treatment. The patient enjoys immediate full ambulation, comparatively free

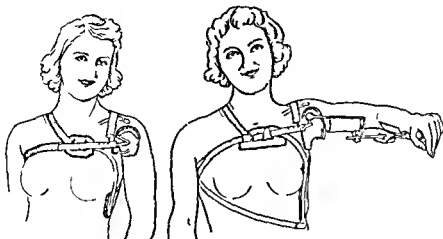


Fig. 14. left. Illustrating the strap over the injured shoulder for certain cases of fractures of the clavicle particularly useful with fractures in the outer third or where a loose central fragment is present. The ends of the strap are fixed by hooks to appropriately located holes drilled through the transverse lever arms front and back. A thick pad fits under the strap at the point of contact with the clavicle.

Fig. 15. Certain fractures of the clavicle are best treated by suspension-elevation with the arm in abduction while occasionally the very difficult case calls for continuous traction. In this instance the rubber axillary hammock supplies both the countertraction and the suspension elevation. Conversion of the clavicle splint into an airplane splint is accomplished through an arm attachment. In addition to using this Burgess airplane splint for difficult cases of fractures of the clavicle it provides a treatment for scapular fractures, fractures of the upper humerus and fracture-dislocations of the shoulder.

use of arm no constriction to breathing usual clothing painless convalescence, and a satisfactory end result.

When it is necessary to confine patients to bed due to the presence of multiple injuries or other complicating factors the advantages of treatment by suspension elevation may be obtained by placing adhesive traction on the arm with the arm abducted to 145 degrees. Only a few pounds traction will be necessary based on the roentgenograms and the position of the fragments. The head of the bed may be elevated to supply countertraction a fracture board is placed under the bed and a small pillow may be placed between the shoulders.

SUMMARY

Although generally considered to be a simple and rather unimportant fracture a check up on the end results of any consecutive series of cases will quickly evidence the failure of usual ambulatory methods to immobilize properly fractures of the clavicle. In adults among whom the fracture is becoming increasingly frequent the deformities persist and an unsightly and unsatisfactory end result follows.

A brief review of the functional anatomy of the shoulder area as obtained by living fluoroscopic studies reveals the primary importance of the

sternoclavicular joint as a functional center for shoulder girdle motion. The surprising degree of motion at this joint is not generally known, yet has an important bearing on the means of immobilization of fractures of the clavicle.

A functional and anatomical approach to the treatment of clavicular fractures is presented whereby the principle of suspension-elevation is utilized. A new ambulatory treatment is advanced incorporating this principle and allowing controlled adjustment of the fracture from points over the sternoclavicular and shoulder joints. Throughout convalescence patient is ambulatory, comfortable, permitted usual clothing and in many cases able to return to certain types of work.

BIBLIOGRAPHY

1. ANDERSON, R. and BURGESS, E. Northwest Med 1939 33 40
2. BERKESEIER, E. J. Surg, Gynec & Obst 1937 64 1064
3. BILLINGTON, R. W. South M J 1931 24 667
4. BOHLER, L. Treatment of Fractures. Baltimore: William Wood & Co. 1933
5. KELTON, W. J. Am M Ass 1917 68 1814
6. Idem. Northwest Med 1936 35 15
7. KLAPP, R. and BLOCK, W. Die Knochenbruchbehandlung. Jüng mit Drahtzügen. Berlin: Urban & Schwarzenberg 1939
8. SPEED, A. Fractures and Dislocations. Philadelphia: Lea & Febiger 1935

CALIBRATED INTERMEDIATE SKIN GRAFTS

EARL C PADGETT, M D, F A C S Kansas City, Missouri

THIS paper has a two-fold purpose first to emphasize particularly the advantages of a type of skin graft which it has not been possible, for the writer at least, to cut previously, namely, a skin graft cut at a pre determined level in the last quarter of the thickness of the skin, second, to present a new method of cutting skin grafts. This method has made the use of a truly deep intermediate graft not only possible but in addition allows one to cut any type of sheet skin graft proficiently and at a uniform depth.

PERTINENT PROPERTIES OF THIN AND THICK SKIN GRAFTS

Using my own cases for material for the purpose of orientation, it would seem pertinent to review briefly certain properties of the 2 types of skin grafts which in my work have proved the most useful, namely, the thin or superficial intermediate graft (2, 4, 5) and the full thickness skin graft (1, 3, 4, 5, 7). On checking the skin graft operations I have performed up to 1938, I found that there were 386 of the thin or superficial intermediate type and 369 of the so called full thickness variety. As my experience grew, however, I found that a decreasing percentage of the full thickness skin grafts were being applied.

The results in so far as contracture, appearance, and percentage of "take" are concerned following skin grafting operations in general are largely dependent upon the relative thinness or thickness of the grafts. The underlying base on which a skin graft is placed tends to contract in direct proportion to the thinness of the graft aside from certain anatomical factors which may be such that a base is formed which prevents contracture (Fig. 1). The final appearance tends away from that of normal skin more or less proportionate to the relative thinness of the graft. That is, a full thickness graft most nearly approaches that of normal skin in appearance (Fig. 2). While a thin skin graft will "take" under proper conditions in nearly 95 per cent of instances on a granulating surface and even in a higher percentage on a clean raw surface (Figs. 3 and 4), only on clean raw surfaces is it wise to attempt to get a "take" with a full thick-

ness skin graft, and even then on concave and uneven surfaces one runs from a 20 to 30 per cent chance of not being able to secure an adequate "take."

Thin or superficial intermediate skin grafts of large size may be obtained easily with relatively little damage to the area from which they are cut. If correctly used on surfaces where weight bearing or repeated trauma are not factors, such a graft may give sufficient protection. As a general rule, the operation can be done quickly. The donor area heals rapidly from the base and one can re take another graft from the newly formed skin after 3 or 4 weeks if necessary. The postoperative dressing period is usually short—from 10 days to 2 weeks. Thus, the correct application of the thinner type of graft sometimes offers a method which in 1 or 2 operations will correct functionally a considerable contractural deformity, or adequately cover a raw area of considerable size. The opposite side of the story concerning the thinner graft is that the appearance is not always satisfactory, contraction tends toward maximum and protection may not be sufficient.

The main advantage of the full thickness skin graft, if one can obtain a perfect "take" of the graft, is that the final result both as to function



Fig. 1 Ectropion of the eye before operation and 3 months after application of the skin graft. These photographs illustrate the amount a thin skin graft will contract unless the base is firm. This graft was $2\frac{1}{4}$ by $3\frac{1}{2}$ inches when it was applied over a stent and still after contracting the area covered by the graft was only $1\frac{1}{2}$ by $1\frac{1}{2}$ inches.

Delivered before the Western Surgical Association, Denver, Colorado, December 2, 1938.

From the Department of Surgery of the University of Kansas School of Medicine.



Fig. 2 This photograph shows how near a full thickness skin graft will assume the appearance of normal skin after it is transplanted. This girl had a large port wine stain covering one half of her face which had been overirradiated causing itching scabiness and telangiectasis. The whole area was excised and a full thickness skin graft was applied. In this particular case we obtained a good take, the graft in spite of the fact that a full thickness graft takes in only about 20 per cent of the cases. At the present time we would correct such a condition by means of a deep intermediate skin graft.

and appearance is the best that can be obtained (Fig. 5). However some superficial loss from blistering and deep loss from focal areas of necrosis is often a feature. Depending upon the extent and depth of the damage the final appearance and alleviation of the functional disability become endangered. A full thickness skin graft will give good protection and tends to develop fairly plentiful subcutaneous tissue. Characteristically, espe-



Fig. 3 This is an example before and 3 months after operation of a rather severe contracture of the axilla which was corrected by means of cross-cutting, removing the scar and applying a skin graft as thick as could be cut with the large knife.

cially if there be considerable blistering and areas of focal necrosis the postoperative dressing period is prolonged over an interval of from 3 to 5 weeks. Finally it is necessary to draw together and to suture the skin edges of the defect which has been produced by the removal of a full thickness skin graft.

SKIN FLAPS

Although somewhat beside the point a word concerning the uses of skin flaps can hardly be omitted, as their merits and demerits must as a rule be contrasted with those of skin grafts when the method of reconstruction is selected. For the



Fig. 4 Method of covering a large raw area with thin skin grafts following a severe burn. At such a time one is only attempting to resurface the granulating area. At a future date the contracture may be cross cut and a thicker graft applied. Photographs show the boy 3 weeks after he was burned above and at the time he was allowed to leave the hospital left. For a number of weeks he was very sick with a high fever and was comatose. He had a rather severe nephritis which gradually cleared up. Patient was advised to return in 2 or 3 months after his general health had improved for correction of a moderate amount of contracture of his legs and arms.



Fig 5 1 photographs showing complete webbing between the second and third fingers of both hands a Ventral view b dorsal view c Photograph of the fingers about 2 months after correction by the application of full thickness skin grafts between the fingers This webbing was corrected in one operation by this method



building of organs a skin flap has no competition when requiring thickness, for filling a depression in the soft tissues, for building a part requiring 2 soft, pliable, epithelial surfaces and some thickness, and as a direct covering for tendons, bones and cartilages, especially if considerable trauma must be withstood (Fig 6, a, b, c, and d) But when a simple surface epithelial covering is the only indication and the blood supply of the base is sufficient, I have as a rule selected the appropriate skin graft believing that it will give the most acceptable result

CALIBRATED INTERMEDIATE SKIN GRAFTS

About a decade ago Blair and Brown, in an effort to combine the advantageous qualities of the thin razor graft with that of the full thickness graft, presented a skin graft alleged to transect the uppermost 25 to 75 per cent of the skin This graft they designated as the "split" skin graft (1) and represented a definite step forward However, I was never able to cut the graft without considerable variation as to thickness and size

It occurred to me after observing the advantages of the "split" graft that if one could cut a uniform graft at a level below that suggested by Blair and Brown and yet keep above the lowermost limits of the corium, such a graft would have desirable

qualities not yet obtainable The ideal graft for many purposes should be directed toward getting a graft of such thinness as to assure successful transplantation, leave the donor site capable of spontaneous regeneration, and yet of such thickness as to afford adequate protection, minimum contraction, and at the same time match the surrounding skin relatively satisfactorily in so far as texture and color are concerned Furthermore, I was of the opinion that if one could vary the thickness of the graft at will, depending upon the region to which it was to be applied and the lesion which it aimed to correct, it might prove desirable for various lesions in different locations to lean toward thinness or thickness as indicated And again, it was my belief that according to the age of the patient and the particular region from which the skin was to be removed, a variation in thickness might be desirable, as it is well known that the skin of children is thinner than that of adults, and that the skin in certain regions varies, as for instance, the skin on the inner thigh of a woman is thinner than that of the outer thigh Moreover, for certain lesions it was evident that if one could remove the skin from any area of the body such as the chest, the back, or over the ribs, certain areas could be resurfaced in a way not possible by the use of the methods commonly practiced

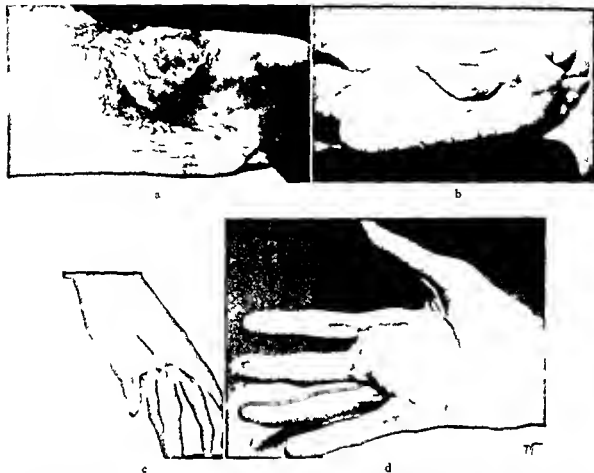


Fig 6 a Photograph of an electrical burn of the plantar surface of the foot which destroyed the skin and subcutaneous tissue over the internal metatarsal bone about one half of the bottom of the foot, most of the inner portion of the foot and one half of the external lengthwise half of the metatarsal bone of the foot. In this case a flap from the opposite leg was transplanted over the area to give a subcutaneous pad and so that the foot could stand the trauma to which it would be subjected. b Photograph

of the foot 2 months after correction. c The palm of the hand was torn off in the cog wheels of a printing press. When the hand was opened the destruction of the soft tissues was such that the flexor tendons of the fingers were laid bare. It was therefore decided to use a skin flap from the abdomen to cover the bare tendons. Although the skin flap was a little thick the function of the hand is normal. d Photograph showing the result after correction.

But to cut a graft such as I had in mind entailed mechanical problems. The ordinary skin graft knife was found to be inadequate. Aside from the difficulties encountered in its application in relation to anatomical location, age and sex of patient, the most formidable objection was the inability to cut a uniform sheet of skin at a predetermined level with any mechanical precision.

THE DERMATOME

With these ideas in mind it occurred to me that if one could draw the skin to a smooth surface and hold it in some manner it could be cut in a sheet of uniform thickness and of a thickness previously

decided upon by passing the knife through the skin at a definite distance from the surface in other words truly an accurately calibrated dermatome.

In 1930 I carried this conception to a mechanical engineer and enlisted his aid to see if I could overcome the mechanical difficulties of the problem. From 1930 to 1937 in a more or less desultory fashion several different mechanisms were discussed, constructed, tried out, and discarded as not being workable or practical. Finally fastening the skin to a smooth surface with cement or adhesive so that the skin would be held firmly to a longitudinally level surface was tried.

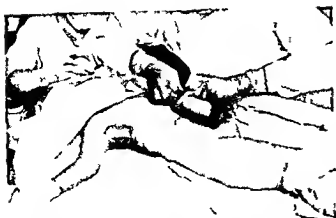


Fig 7

Fig 7 Adhesive cement is applied to both the drum and the skin. The photograph shows the machine working along, cutting the skin from the abdomen in a perfect sheet. This skin graft is to be used to correct the axillary contracture shown in the photograph. In the second photograph the sheet of skin is being pulled away from the drum with hemostats. It will be noted that the sheet is the same size as the drum and that it is a perfect rectangular shape of uniform thickness.

Fig 8 The dermatome standing on its rack. A Support of drum. B screw calibrated to cut of an inch for each line on the head of the screw. The screw may be turned with a screw driver or with the thumb and forefinger. C A tube with a round shaft inside into which the calibrating screw turns which raises E the holder for the knife blade. A similar screw is on the opposite side with a duplicate of the same mechanism so that the knife blade may be raised or lowered at each side. The knife blade is drawn to the drum in the zero position and moved away from the drum by the double calibrating screws to determine the thickness of the graft to be cut. This provision is necessary but one has to reset the knife after each honing or grinding of the knife blade as this changes the distance of the knife blade from the drum. G is the handle by which the shaft is worked backward and forward by hand as shown in Figure 7. D is the knurled handle which is held in the opposite hand to rotate the drum as the knife holder or knife is turned around the drum. F is the base of the rack on which the dermatome rests when placing the adhesive on the drum. When placing the knife blade in position or when the skin is being pulled away from the drum.

The dermatome is essentially a drum like skin holder with a shaft passing through a hand holder which is the means of rotating the drum on the shaft and permits reciprocation of the shaft relative thereto with a knife blade

A mechanism consisting principally of a drum with a movable knife fixed at a definite distance from the drum was constructed. It was found that it was possible with the greatest facility and ease to remove a sheet of skin as large as the drum, or $4\frac{1}{2}$ by 8 inches (Fig 7) or smaller to cut it absolutely uniform in thickness, and that the thickness could be varied as described by turning a calibrating mechanism which varied the distance of the knife from the drum in a predetermined fashion. Furthermore, it was found that the graft could be cut to pattern, if one wished,

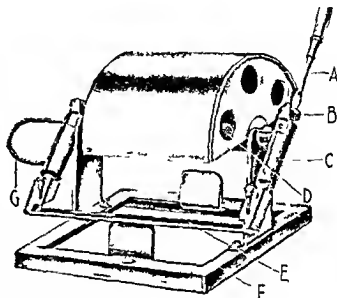
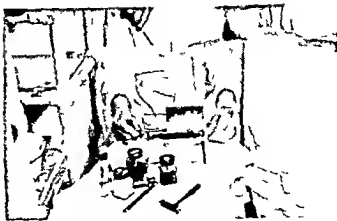


Fig 8

held by a supporting frame passed through spaced bearings to support the shaft. In the arms of the knife frame is a calibrating mechanism so that the distance of the knife blade can be set away from the drum at a predetermined distance. The principle of the dermatome is that the skin surface of the determined skin graft is held in contact with the drum while a knife blade transects the determined graft at a fixed distance from the drum thereby severing the graft from its bed at a uniform level throughout.

by nullifying the adhesive properties of the cement by painting out the area not to be removed with a solution of talc and ether. This solution prevents adherence of the skin to the drum. During the summer of 1938 the final model was worked out which, although embodying the fundamental idea of bringing the skin to a smooth surface, contained several very definite improvements which have greatly facilitated the use of the machine (Fig 8).

Since the perfection of the dermatome in 1938 I have had occasion to employ 83 calibrated

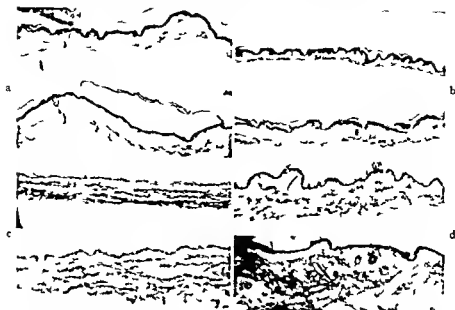


Fig 9 a and b Sections of Thiersch skin grafts c and d Sections of split skin grafts showing variation in thickness $\times 16$

a Thiersch graft cut from outer thigh adult male about .010 of an inch in thickness (.25 millimeter) b Upper section Thiersch graft cut from outer thigh of male age 8 years about .007 of an inch in thickness (.18 millimeter) Lower section Thiersch graft cut from outer thigh of male about .010 of an inch in thickness (.25 millimeter) c Split graft cut from outer thigh of adult male shows variation from .010 of an inch (upper) (.25 millimeter) to .014 of an inch (lower) (.46 millimeter) in thickness same graft d Split graft cut from outer thigh of adult male shows variation from .010 of an inch (.25 millimeter) to .018 of an inch (.46 millimeter) in thickness same graft

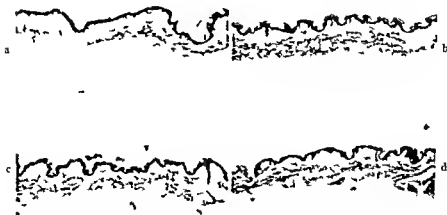


Fig 10 Sections of typical split skin grafts $\times 16$

a Split skin graft from outer thigh of an adult male thickness about .012 of an inch (.3 millimeter) at maximum b Split skin graft cut from outer thigh of boy age 9 years thickness about .013 of an inch (.33 millimeter) to .014 of an inch (.36 millimeter) c Split skin graft cut from inner thigh of a fat woman thickness about .013 of an inch (.33 millimeter) to .014 of an inch (.36 millimeter) at maximum d Split skin graft from outer thigh of young adult male thickness about .013 of an inch (.33 millimeter) to .014 of an inch (.36 millimeter) at maximum

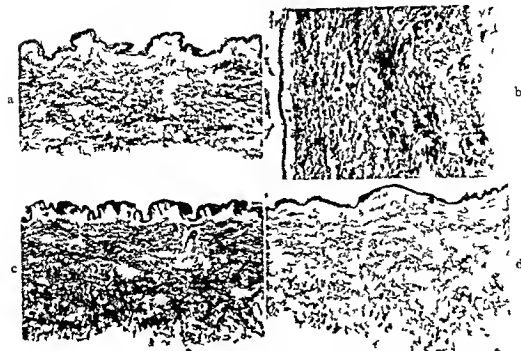


Fig 11 Sections of full thickness skin grafts cut with scalpel showing variation in thickness $\times 16$

a Full thickness skin graft cut with scalpel from the abdomen of an adult male thickness about 0.32 of an inch (8.1 millimeter) b Full thickness skin graft cut with scalpel from abdomen of an adult male about 0.40 of an inch (1.01 millimeter) in thickness c Full thickness skin graft cut with a scalpel from the abdomen of male child age 8 years about 0.34 of an inch (8.6 millimeter) in thickness d Full thickness skin graft cut with scalpel from abdomen of an adult male from 0.28 of an inch (7.1 millimeter) to 0.34 of an inch (8.6 millimeter) in thickness



Fig 12 Sections of thin and moderately thick calibrated skin grafts $\times 16$

a Male adult graft cut from abdomen about 0.10 of an inch (2.5 millimeter) in thickness used to cover a granulating area. A good take b Male adult graft cut from abdomen about 0.12 of an inch (3 millimeter) in thickness used to cover a granulating area. A good 'take' c Male adult graft cut from abdomen about 0.18 to 0.20 of an inch (4.6 to 5 millimeter) in thickness. Graft used to cover back of hand on clean raw surface. A perfect take. No blistering d Male adult graft cut from outer thigh used to cover clean raw surface of dorsum and palm of both hands 0.14 to 0.16 of an inch (3.6 to 4.1 millimeter) in thickness. A good take

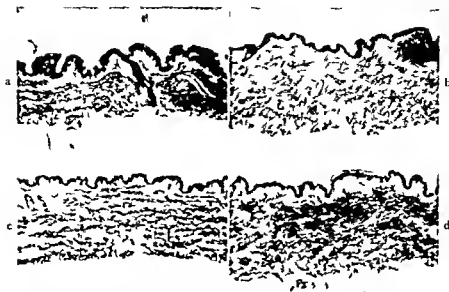


Fig. 13. Sections of thick calibrated skin grafts. X16
 a Graft cut from abdomen of boy 8 years old about .020 of an inch (5 millimeter) in thickness. b Graft cut from abdomen of woman age 60 years pregnant previously about .025 of an inch (63 millimeter) in thickness. c Graft of male age 14 years cut from abdomen about .025 of an inch (63 millimeter) in thickness. d Graft of male age 65 years cut from thigh about .030 of an inch (76 millimeter) in thickness.



Fig. 14. Photograph of a granulating wound caused by a severe burn of the thighs, the knees, the upper legs and popliteal spaces. The area involved both the extensor and the medial surfaces of both legs. To correct this area 2 operations were involved. In the first operation 744 square centimeters of skin were removed from the upper chest and anterior abdominal wall. This amount of skin covered about one half of the denuded area but we considered it about all he could stand at 1 operation. Three weeks later at a second operation 781 square centimeters of skin were removed from the same areas. By that time the subepithelial cells had caused regeneration. This allowed us to resurface his legs in 2 operations. This is the type of case in which formerly death resulted very often because it was impossible to cut enough skin from the back and abdomen to cover the lower extremities. This was particularly true if the patient was a baby or was emaciated. In the second photograph are shown the denuded areas about 10 days after the first operation.



Fig 15 In this boy 2 operations were necessary. The granulating areas were first covered by thin calibrated skin grafts .012 of an inch in thickness and he was allowed to go home. After several months he came back with a certain amount of contracture in the popliteal space. At this time we had a healed field in which to work. After cross-cutting the scars, moderately thick calibrated skin grafts .018 of an inch in thickness were cut from the abdomen and applied over the denuded areas. The lateral and posterior views of leg show the functional result about 3 months after the second operation.

grafts. I found that I could cut skin at any predetermined, uniform depth and that it was possible to cut consistently at a depth of 75 to 95 per cent of the thickness of the skin, a deep intermediate graft which previously I had not been able to cut accurately.¹ It was also found that the dermatome was equally useful in cutting thinner grafts of almost any predetermined thickness, even as thin as .008 of an inch in thickness. The dermatome was found to be particularly useful in cutting various thicknesses of superficial intermediate skin grafts.

¹When it is desired to be absolutely accurate in percentage depth, it is well to incise the skin vertical to its surface to judge the thickness of the skin before setting the calibrating mechanism of the dermatome.



Fig 16 Example of obliterated eye socket which was grafted using a large stent about which a calibrated intermediate skin graft was draped .024 of an inch in thickness. Although the contracture is considerable in such cases room was left for an artificial eye. The photographs show the skin graft in socket and the result with an artificial eye in place.

VARYING THICKNESS

In an adult when the main indication was one of resurfacing a granulating area usually the graft was cut from .010 of an inch, or 25 millimeter to .014 of an inch, or 36 millimeter, in thickness (Figs 9 to 13). When a clean raw surface was to be covered and the indication was one in which the appearance was a prime factor or it was essential to have minimal contracture, ordinarily the grafts were cut from .022 of an inch, or 56 millimeter, to .028 of an inch or 71 millimeter. It was found that at this thickness sufficient subepithelial elements remained in the base for early regeneration. When maximum appearance or minimum contracture were not such clear cut indications and the certainty of "take" seemed to rank relatively high in the balancing of the essential factors, the grafts usually were cut between .016 of an inch, or 41 millimeter, to .020 of an inch, or 5 millimeter in thickness. Observations were made on the thickness of the skin in varying locations and in both sexes.

In a woman sometimes after repeated pregnancies if the skin over the abdomen, the inner thigh, or the inner upper arm is removed at a level of .018 of an inch (.46 millimeter) to .020 of an inch (.5 millimeter) all of the subepithelial elements will be removed. The variation in the thickness of the skin in various locations varied in the male but not to as great an extent as in the female. Coincidentally, while making these observations on the thickness of adult skin, children were being operated upon and their skin thickness was checked. In a young child 6 years of age for instance, if one cuts a graft from the abdomen of as little thick-



Fig 17 Photograph of boy who had a marked fixation of his arm to his chest wall due to an old heavy scar a Anterior view b Posterior view The scar and granulations were excised The arm was hyperextended leaving a very large denuded area from the elbow to the lower rib region Calibrated skin grafts of deep intermediate thickness were taken from both thighs and applied to the raw area Four drums of skin were used In this case the grafts were 018 of an inch in thickness c and d Show the result about 3 weeks later e and f Show the result 1 year after the grafts were applied

ness as 014 of an inch (36 millimeter) to 016 of an inch (4 millimeter) he may remove all of the subepithelial elements of the skin and healing will be by secondary intention When a calibrated graft is removed from a baby 2 or 3 months old to leave sufficient epithelial elements in the bed for regeneration one can hardly cut the graft more than 010 of an inch (25 millimeter) to 012 of an

inch (3 millimeter) in thickness When the child is about 12 to 14 years of age one cannot cut lower than 016 of an inch (41 millimeter) to 018 of an inch (46 millimeter) in thickness

COMPARISON OF SKIN CUT BY VARIOUS METHODS

Coincidentally with the cutting of a calibrated skin graft a Thiersch graft and a split graft cut



Fig. 18 Example of a patient who had a fixation of his arm to the chest. Pin point grafts had been applied by another surgeon. At the time the photograph was taken healing had occurred but he could not extend his arm. In this case the scar was cross cut and a skin graft of deep intermediate thickness .024 of an inch was applied to the axilla. He also had a contracture in the elbow region which does not show in the first photograph but the area which was grafted shows in the final photograph. Right which was taken 4 months after the operation.



Fig. 19 Photograph of patient with marked cicatricial contracture of the lower mental region, the neck, the upper chest, the right axilla, and the right elbow region. Three operations were necessary to correct this deformity and deep intermediate skin grafts .018 of an inch in thickness were used to correct the contractures. At each operation good takes occurred but there was a certain amount of subsequent contracture. The photographs show patient before operative procedures were instituted and 4 months after the last operation.

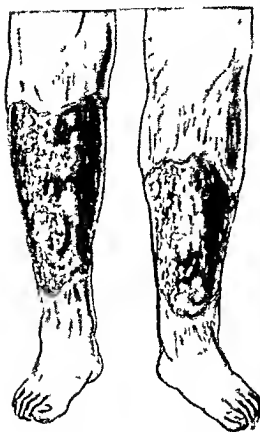


Fig 22 Drawing of a severe burn of both legs. Granulating areas were still present after 18 months and there was no tendency to heal. In this case granulating areas were completely excised so that a clean scar base was present. Two large calibrated skin grafts taken 1 from the abdomen and 1 from the thigh were applied to the clean raw base. The photograph shows the final result 6 months later. The man's skin is nearly normal in appearance and a fair subcutaneous tissue has developed beneath the skin. There is no tendency for the skin to break down.

and that a graft of very large size may be taken from locations not previously available. For instance, skin grafts have been obtained from the pectoral and scapular regions in markedly emaciated individuals, the lumbar region, the posterior gluteal region, relaxed pendulous abdomens and over the ribs if the patient is not too emaciated, all in regions in which the skin graft knife despite the utmost dexterity is of no great use. Therefore, the good advantages available to the surgeon when using this type of graft are mainly attributable directly to the dermatome.

Foremost, one cannot but be impressed by the area of skin that is available to one. This factor alone allows one to graft successfully a type of individual occasionally seen who in the past has been nearly hopeless, as for example, the type of patient with a large denuded surface covering both thighs and legs where most of the remaining skin is on the trunk (Figs 14 and 15).

In a case of this type with both legs denuded, at the first operation 744 square centimeters of

skin were removed from the abdomen and anterior chest in 6 large sheets. This covered about one half of the denuded area. Three and a half weeks later at a second operation 781 square centimeters of skin were removed from the same areas previously used allowing a completion of the resurfacing. Several times as much skin as taken in this case has been removed from similar patients.¹ Because of the fact that one can obtain a uniform large sheet of skin to drape over a form or stent, a graft which is cut by the dermatome is particularly satisfactory when a cavity is to be grafted as in Figure 16 which shows a case of an obliterated eye socket.

On a baby one cannot cut by hand with a skin graft knife a graft of sufficient size to be very useful if one has a large defect to cover. With the dermatome a graft of large size may be taken from either the abdomen or the chest. It may be ex-

¹A warning might be wise here. A blood transfusion may be necessary because of loss of blood serum when too much of the body surface is denuded. The same factors obtain when there is too much denudation following a burn.



FIG. 23. a Basal cell epithelioma of the side of the forehead which had been unsuccessfully irradiated with a recurrence. This area was excised and intermediate skin grafts .026 of an inch in thickness removed from the abdomen were applied. b Appearance 2 months later. c This patient had a scar which had drawn her upper eyelid out of place and had destroyed her eyebrow. In this case a deep intermediate skin graft .026 of an inch in thickness was applied after the scar was excised. A full thickness skin graft was removed from the scalp to make her an eyebrow. d Appearance of the graft and the eyebrow 1 year later.

tremely difficult or impossible to cut sufficient skin from available areas with the large skin graft knife and do much in the way of resurfacing when the individual is very emaciated as may occur when one sees a severe burn a number of months after its occurrence. As a matter of fact in our routine work practically all of our grafts are cut by the dermatome at the present time (Fig. 8). The ease, the accuracy and the quickness of the method recommend the constant use of this mechanism.

THE DEEP INTERMEDIATE SKIN GRAFT

Our experience with the deep intermediate skin graft as cut with the dermatome indicates that by proper cutting provided other factors such as proper fixation, tension, hemostasis, pressure and a clean field are obtained, the chance of failure of take is nearly eliminated. Because the certainty of "take" is increased one can extend the magnitude of his reconstruction to limits not advisable previously. Difficult areas to graft with thick grafts such as the lateral cheek, the neck and the axilla and dorsum of the hand become acceptable cases in which successful repair is to be expected and not just hoped for (Figs. 17, 18, 19, 20, 21 and 22).

The fact that this type of graft shows little blistering or areas of necrosis causes the final appearance to approach that of normal skin (Fig. 23). Its appearance is as good as that of a full thickness graft after a perfect "take". These factors plus the fact that the donor area does not have to be sutured as it heals in from 10 to 14 days (Fig. 24) has caused us to cease using the full thickness skin graft except in babies where the amount of skin necessary is slight as in web fingers (Fig. 5).



FIG. 24. Photographs of abdomen and thigh of the patient shown in Figure 18. This photograph was taken 3 weeks after the skin grafts had been removed. The grafts were .024 of an inch in thickness.

SUMMARY AND CONCLUSIONS

To recapitulate, the deep intermediate skin graft as cut with the dermatome is comparatively certain to "take." The new graft shows practically no blisters or local areas of necrosis. It may be cut to pattern if one desires. The ultimate contraction is reduced to a minimum. Good protection is offered. The appearance as a rule approaches that of normal skin. The donor area heals quickly. The postoperative period of care is relatively short. Finally, as a rule, the usual run of lesions may be corrected in one operation.

The properties of skin grafts in general are summarized. The development of the dermatome has removed many of the mechanical difficulties of cutting a skin graft of the needed size and correct thickness. Microscopic examination of the thickness of the average graft as cut by various methods suggests a more accurate reclassification as to thickness. It is now possible to use grafts in certain cases in which formerly a

successful result was sometimes not possible to obtain.

A deep intermediate skin graft, which has advantages over the full thickness skin graft, cut at a level ordinarily not possible before the development of the dermatome is described.

REFERENCES

- 1 BLAIR V P The full thickness skin graft Ann Surg 1924 80 298-310
- 2 BLAIR V P, and BROWN J B The use and uses of large split skin grafts of intermediate thickness Surg Gynec & Obst 1929 49 82-97
- 3 PADGETT E C Full thickness skin grafts, etc J Am M Ass 1932 98 18-23
- 4 Idem Care of the severely burned with special reference to skin grafting Arch Surg 1937, 35 64-84
- 5 Idem Skin grafting in severe burns Am J Surg 1939 43 626-636
- 6 THIERSCH KARL Ueber die feineren anatomischen Veranderungen bei aufheilung von haut auf granulationen Verhandl d deutsche Gesellsch f Chir 1874 3 69-71
- 7 WOLFE J R New method of performing plastic operations Brit M J 1875, 1 360



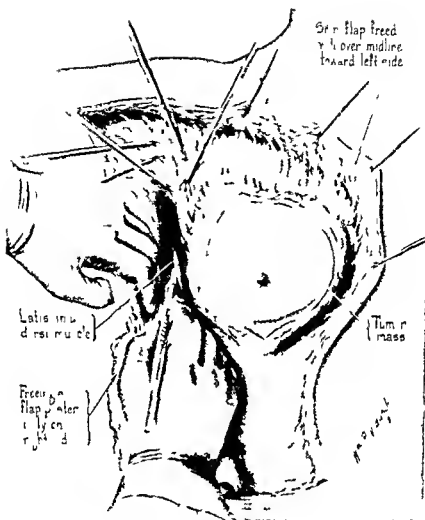


FIG. 3. Dissection of the skin flap down to the latissimus dorsi.

4. Method for the Prevention of Elephantiasis Chirurgica — Elliott H. Hutchins

A METHOD FOR THE PREVENTION OF ELEPHANTIASIS CHIRURGICA

ELLIOTT H. HUTCHINS, M.D., F.A.C.S. Baltimore, Maryland

On October 7, 1931, my attention was called to a patient who presented an unusual picture. He was operated upon by me when he was two years of age for an infection of the ankle which had developed while he was playing in a field where his mother was picking beans. I had not seen him from that day until he appeared in my office, practically a grown man. He had an enormous swelling from the groin to the foot on the affected side. There were no visible scars about the groin and no induration suggesting scar tissue sufficient to block the lymphatics. He had a temperature and was rather ill, on admittance to the hospital he had a moderate degree of pain. The swelling was peculiar in that the skin was transparent, pitted on pressure, and the entire thigh and leg had the appearance of an acute edema. I was unable to determine what caused the swelling or why it subsided almost to the point of disappearing while he was under observation. While it apparently did not have any connection with his foot at the age of two, the infection may have produced scar tissue of a permanent type in the neighborhood of the glands in the groin, simulating rather closely that which occurs in the axilla following a breast amputation, but differing when the increased mobility of the tissue in the groin is compared with that in the axilla. The clinical picture presented by this patient suggested Milroy's disease.

On August 3, 1936, a patient came into my office with a swollen arm following a radical operation for the cure of cancer of the breast. The appearance of her arm resembled in a striking manner the leg just mentioned. The fingers, forearm, and arm were swollen to their capacity, the skin appeared as though it would break if subjected to any further pressure. It had the appearance of being distended so rapidly that it had not had sufficient time for the development of fibrosis. The chest on the affected side in this patient offered mute evidence of the amazing mutilation of which a surgeon can be guilty. As contrasted with the normal side, the affected side showed a depressed area the floor of which was composed of epithelialized scar tissue firmly adherent to the underlying bony cage formed by the

ribs. This type of tissue also covered what was once an axilla. The complaint of the patient, in addition to the swollen arm, was that she felt as though she were in a vise and could scarcely breathe. She had considerable pain in her arm, not sharp but a dull ache. This patient and the one just mentioned had a blockage of a group of lymphatics followed by a swelling of the areas drained. In the first case the lymphatics of the thigh were involved, and in the second the lymphatics and blood in the arm. In the first case there was something as yet undiscovered, which permitted an easing of the tension and allowed circulation to be reestablished. The second patient was not so fortunate, for her there was no release.

According to the literature edema in elephantiasis filariosa is not caused by blockage of the lymph glands and vessels alone. There is something else necessary. It would seem, therefore, that the cause or causes for the 2 clinical pictures



Fig. 1. Swollen arm, brawny arm or elephantiasis chirurgica.

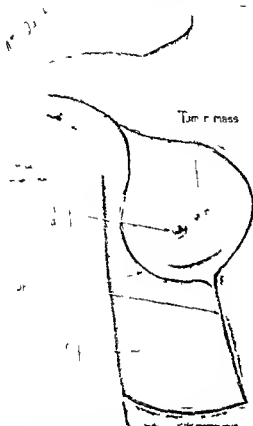


Fig. 2 Outline of incision permitting adequate exposure and thorough dissection of the axilla with reasonable margin of skin to be left and extension to permit adequate exposure to the opposite side of the sternum beneath of the rectus muscle and latissimus dorsi



Fig. 5 Transfixion and ligation of the insertion of the pectoralis major and division of the pectoralis minor

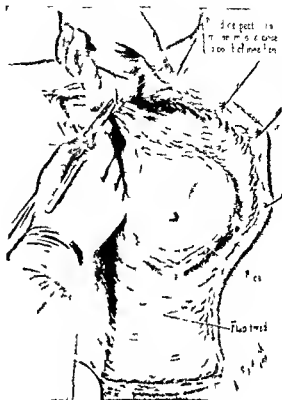


Fig. 4 Division of the pectoral muscles

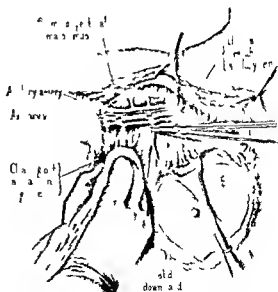


Fig. 6 Stripping of the axillary vessels preliminary to dissection of the axilla

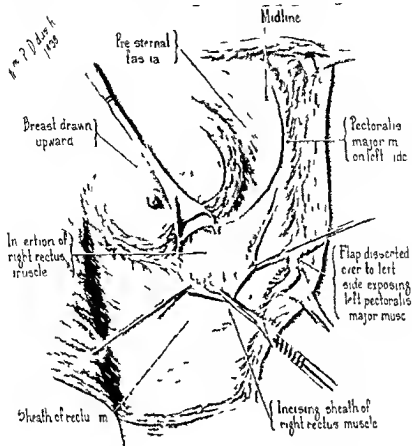


Fig 7 Dissection of the fascia on the opposite side of the midline exposing the fibers of the pectoralis major also for the removal of the upper portion of the sheath of rectus in anticipation of cancer cells driving against the lymph current

cited is not due to the disturbance within the vessels and glands alone but also to something in the environment about the vessels. In a swollen arm which returns to normal a favorable change takes place in the environment, while in the permanently swollen arm there must be, in addition to the disturbance within the vessels, a change in the environment constantly present, operating continuously and increasingly to bring about a condition so distressing as that shown in Figure 1.

While many contributions have been made concerning swollen arm, brawny arm, or elephantiasis chirurgica following operation for cancer of the breast, no one satisfactory explanation has been offered. In the new and rapidly accumulating literature no one has explained why one patient operated upon for cancer of the breast, using the complete method, should be plagued by a swollen arm, while another patient treated by the same method should escape entirely, or why one patient should have a swollen arm immediately after the operation, clearing up later, while

in another the swelling may be deferred for a long time but then become permanent once it is established.

Halstead has mentioned what most of us have observed, that these swollen arms are easy prey to streptococcus infection. He suggested that nerve injury may, in a measure, be responsible for this. That would hardly seem acceptable in the light of MacCallum's experiment in which he demonstrated that the injured limb reacted to infection in a manner very similar to the uninjured limb.

Nothing has been said relative to the fate of the artery in the dissection of the axilla or following it. We have evidence to prove that the same artery is on occasion embarrassed by pressure exerted by a cervical rib resulting in aneurism distal to the constriction. It would seem by analogy that a similar condition would be produced in the axilla, yet I have never seen it.

While swollen arms have frequently resulted from massive cancers in the axilla or neck without operation of any kind, one gains from the litera-

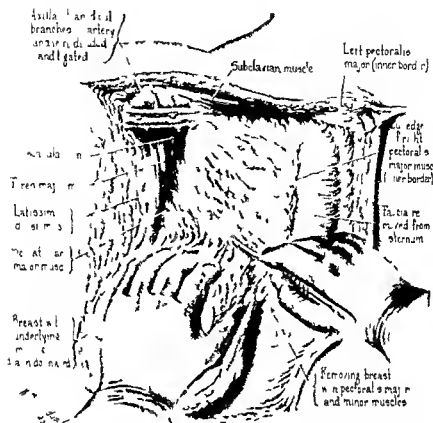


Fig. 5. The axilla cleaned exposing the cephalic veins, major latissimus dorsi, serratus, the subclavian muscle and pectoralis major on the opposite side. The scraping off of the pectoralis minor muscle, leaving tiny fragments of muscle tissue.

ture the impression that this difficulty in its post-operative form did not exist as a menace until knowledge of the pathology of cancer of the breast first noted by Heidenhain compelled the complete removal of both pectoral muscles in order to carry out a surgically correct procedure for the cure of cancer of the breast. By these data one wonders whether the changed environment is brought about by the more complete dissection afforded by better exposure following the removal of these muscles or whether the muscles acted as a framework to permit the relaxed condition of the tissue about the vessels and lymphatics to accommodate the changes in volume of these tissues when called upon to meet unusual emergencies or whether these structures acted as adjuvants to the two circulatory systems serving as a medium of exchange in the reconstruction of the lymphatics in those patients whose axillae were cleaned without destroying the muscles.

The classic experiment of Reichert immediately comes to mind. He demonstrated very conclusively the ability of the lymphatics by practically amputating the leg of a dog and noting the rapid re-establishment of circulation through the scar tissue. That while convincing for the leg does not seem applicable to the very markedly different environment offered by the axilla. In the former case there is great mobility of tissue in the latter there is practically none.

Halstead in his contribution on the swollen arm published in the Johns Hopkins Hospital Bulletin in 1921 suggested that infection at the time of the operation or following the operation may be responsible in part at least for this condition. It was he who gave it the name elephantiasis chirurgica.

The following case would seem to contradict Halstead's view in a measure at least. Mrs. H. was operated upon by me in 1913 for cancer of the breast. She had an uneventful convalescence

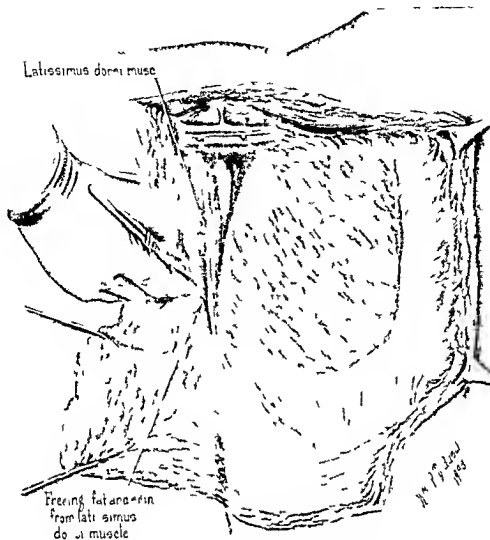


Fig. 9 The dissection of the outer surface of the latissimus dorsi muscle

and for 25 years had no trouble whatsoever. Two years ago she wrote me stating that she was perfectly well except that her forearm and arm on the affected side were beginning to give her trouble and that her fingers and hand had begun to swell.

Other writers have offered many suggestions but most of them apparently are of the opinion that the swelling is due to destruction of the lymph filtering plant in the axilla with partial or complete destruction of the veins plus tension which constantly tends to increase as the result of the contraction of scar tissue in a more or less rigid environment. If this be true any treatment to be effectual must be directed toward a re-establishment of the axilla in a manner at least approaching that which obtained previous to surgical interference. Since this condition seems to have followed the removal of the pectoral muscles the new framework in the re-establishment of

the axilla must, in a measure, simulate the function of these muscles. Halstead saw that, and in his clinic the accepted dictum was that the person who made the incision should not have to close it and that it was bad surgery further to increase the tension about the axilla by reuniting flaps under pressure. It was he who suggested that instead of reuniting the flaps under pressure the other extreme should be effected by pressing them back thus permitting the greatest amount of freedom of the tissue. The remainder of the deformity was covered by skin grafts. He noticed a marked improvement following this operation.

Utilization of the pectoral minor muscle has been suggested by several surgeons. Probably the first was the late John B. Murphy of Chicago, but he stated that inasmuch as cancer cells had been found in the major muscle and also between the two muscles it would seem rather risky to utilize either of these muscles in a plastic operation.



Fig. 10 Dissection of the inner surface of the latissimus dorsi muscle

In our efforts to prevent morbidity following an operation upon the breast the one thing that transcend all others in importance is the fact that we are dealing with cancer and no tissue that will be a threat to the patient should be allowed to remain.

Transplantation of fat has been suggested and perhaps would be of benefit but to be successful it would seem that the structure transplanted must be a viable structure with a superabundant blood supply and the possibility of simulating in a fashion the function that the pectoral muscles probably played in preventing contraction before the complete operation came into use.

On September 17, 1936 immediately after visiting the patient mentioned at the beginning

of this paper, I operated upon a patient who had cancer of the breast. With the swollen arm and distressing condition of that patient fresh in my mind I attempted a new method which promised to bring about the desired result as mentioned in conjunction with the function probably played by the pectoral muscles.

The only available muscle and muscle tissue seemed preferable to any other for this purpose which would lend itself physiologically and mechanically was the latissimus dorsi. It has the advantage of being away from the lymph current which drains the breast. It has a broad origin fan shaped the greater part of which is made up of muscle tissue a reputedly desirable medium for the restoration of lymphatic circula-



Fig. 11 Freeing of the latissimus dorsi preliminary to transplantation

tion It will cover a large area of denuded chest wall. It may be dissected with the greatest ease, both from its origin and from the bands of muscle tissue attaching it to adjacent structures. While it narrows as it approaches its insertion, it is of sufficient volume to cover not only the axillary vessels but also the entire denuded area from which the breast was removed. The attachment of this muscle to the clavicular portion of the pectoral major in appropriate cases, to the subclavian muscle, and to the small remnants of the pectoral minor muscle left for that purpose, is effected by silk sutures. The nerve and blood supply are easy to preserve if proper care is exercised during the original axillary dissection. In those cases of deferred skin grafting the area

covered by muscle presented a very desirable, smooth surface with abundant blood supply. The small area which could not be entirely covered with muscle presented a greatly inferior, granulating surface.

Since that operation we have had 12 cases suitable for the application of this method. There has been no occasion to regret the procedure in any of these cases. The operation can be done in $1\frac{1}{2}$ to 2 hours. The transplantation accomplishes the following things: (1) It obliterates a troublesome dead space. (2) It covers the vessels with tissue of a pliability resembling in a measure the looseness which originally existed in the axilla. (3) It increases the mobility of the shoulder joint. (4) By attaching it to the subclavian

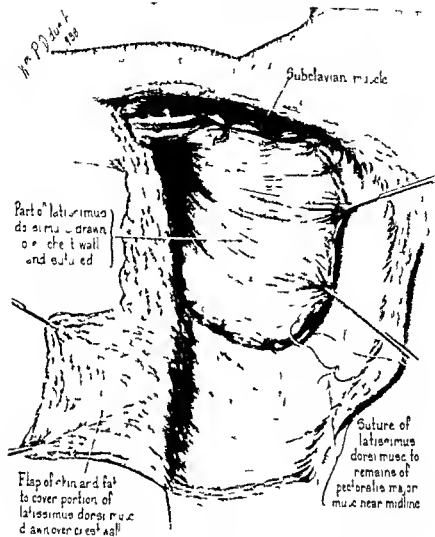


Fig. 17 The latissimus dorsi being sutured in its new position

muscle and the tags of the pectoral minor muscles left for that purpose it would seem ideally adapted to the regeneration of new blood vessels and lymph vessels (5) The muscle juice undoubtedly has a hemostatic influence in the small amount of oozing that practically always follows such a radical dissection (6) It gives a healthy base for skin grafts either immediately applied or deferred (7) It lends smoothness and mobility to the tissues about the ribs that were so cruelly left with immediate skin graft resulting in what every surgeon would avoid namely scar tissue attached to bone (8) Finally it lays the foundation for what we have in mind namely to fashion

out of the abdominal fat something simulating the original breast

Elephantiasis chirurgica is a morbid condition having its origin in the completeness with which efforts to cure cancer following the discovery of cancer cells in and among the pectoral muscles were made by Willy Meyer and W. S. Halstead. It apparently results from a change in tension of tissues in the axilla perpetual by nature and of increasing degree it may become so extensive that amputation of the shoulder joint is advisable it may follow any and all breast operations.

This operation is an effort to bring about 2 things

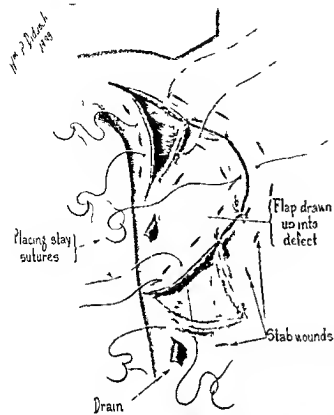


Fig 13

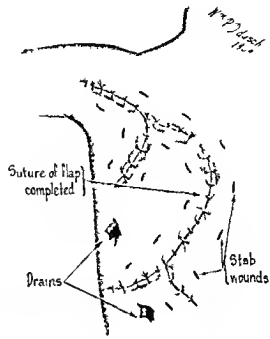


Fig 14

Fig 13 An effort to close the incision with a flap from the abdominal wall with perforations on the margins to permit escape of fluid for the purpose of anchoring the flaps by granulation

Fig 14 Closure of the incision which has been modified in recent cases

Fig 15 The mobility of the arm 10 days after operation



Fig 15

1 An approach at the time of the operation toward the re establishment of the axilla by the plastic method to a degree or point as near the original as possible

2 An effort to construct an artificial breast out of the abdominal fat at the time of operation

and thus help to avoid the psychosis following operation

In order to reconstruct the axilla more completely it may be advisable not only to detach the latissimus dorsi at its origin but also at its insertion and to re insert it in the coracoid proc

ess This would provide a framework for the axilla resembling in many respects the part played by the pectoral minor muscle

While the mortality of cancer of the breast is constantly improving the morbidity of the breast is a constant menace and should have the most serious attention of every surgeon operating for that condition

BIBLIOGRAPHY

- 1 BAMES H O Med Rec 1936 143 273-246
- 2 COUGHLIN W T Surg Gynec & Obst 1927 45 523-529
- 3 GILBRIDE J J Am J Surg 1936 32 463 466

- 4 GREIG DAVID M Edinburgh M J 1916 17 23 26
- 5 HALSTEAD W S Johns Hopkins Hosp Bull 1911 32 309-314
- 6 HARTSHORN W S Boston M & S J 1923 188 473
- 7 IREWS NORMAN Am J Cancer 1931 pp 151-152
- 8 IERICH REVE Angina Pectoris 1935
- 9 MURPHY JOHN B Surg Gynec & Obst 1906 2 84
- 10 NORLE C H South M J 1931 24 841 843
- 11 PASQUALE J H Tr Roy Soc Trop M & Hyg 1929 21 69
- 12 PRUITT M C J Med Ass Georgia 1924 13 471
- 13 SITTENFIELD MORRIS J Urol & Cutan Rev 1924 29 319
- 14 VEAL J R J Am M Ass 1936 108 1236 1246

EXTRAPLEURAL PNEUMOTHORAX

ALAN J HRUBY M D RICHARD DAVISON, M D F A C S and GILBERT SCHNEIDER M D
Chicago Illinois

COLLAPSE therapy has proved to be the most successful method of treatment of pulmonary tuberculosis. The mechanism of this benefit is not universally agreed upon but results are attributed to closure of the cavity, rest of the part, circulatory changes and alteration of condition in the tissues resulting in circumstances less favorable for development of the tubercle bacillus. Collapse therapy measures have been successful in direct proportion to their mechanical effectiveness provided of course there are no serious sequelae to the operation.

Intrapleural pneumothorax is the most valuable collapse measure but is ineffective unfortunately in many cases because of adhesions. Thoracoplasty has been by far the most successful surgical measure but has certain objections in multiplicity of hazardous operations resulting deformity, and disability. Other members of the collapse armamentarium which have been of some value are (1) intrapleural pneumonolysis (2) phrenic nerve operation (3) extrapleural pneumonolysis (principally paraffin packing) (4) scalenotomy, (5) intercostal neurectomy (6) various revision and supplementary thoracoplasty (7) pneumoperitoneum and (8) oleothorax. Recently a new collapse therapy procedure has been introduced which gives promise of being of definite value. This is extrapleural pneumothorax.

While Tufier performed this operation in 1910 the real credit of its development and popularity belongs to Graf of Dresden and Schmidt of

Heidelberg. Others who have commented on the subject or reported their experiences are Beley, Overholt and Tubbs, Rhodes, Monod, Brock, Roberts, Sellors and Sauer.

INDICATIONS

The exact indications and possibilities of the operation cannot as yet be definitely determined. Brock states that extrapleural pneumothorax should be done in every case in which intrapleural pneumothorax is indicated but fails, although he is of the opinion that in certain cases thoracoplasty is fundamentally the operation of choice.

We have proceeded upon the theory that the earlier lesions and smaller soft cavities would be easiest to collapse and cases with large thick walled cavities and heavy apical caps would be controlled best by thoracoplasty. Needless to say the operations are reserved for those cases in which pneumothorax is not possible and in which the other more simple measures will probably not be effective. One outstanding adaptation of the procedure will probably be found in controlling progressive contralateral lesions in pneumothorax and thoracoplasty cases. We believe that any hope that extrapleural pneumothorax will largely replace thoracoplasty will not be realized.

OPERATION

We have chosen an approach similar to that for an upper stage thoracoplasty believing that we should be prepared to resort to thoracoplasty if conditions suggest that this would be the wiser



Fig 1 Case No 36,99 F J white male age 21 years Admitted to Municipal Tuberculosis Sanitarium October 11 1935 Diagnosis far advanced pulmonary tuberculosis sputum positive on admission Artificial pneumothorax right started November 1 1935 continued at present



time Sputum positive Phrenic resection left, November 19, 1936 Sputum positive Extrapleural pneumothorax left established March 28 1938 Sputum negative since patient in excellent general condition Roentgenograms made February 8 1938 and April 20 1938

Anesthesia has been local infiltration with novocain supplemented with cyclopropane gas A paravertebral incision is made transgressing the

trapezius and rhomboid muscles and a few fibers of the latissimus dorsi About 4 to 6 inches of the fourth rib is removed, and then a cleavage plane



Fig 2 Case No 44,572 R J white female, age 26 years Admitted to Municipal Tuberculosis Sanitarium October 13 1937 Diagnosis far advanced right apical tuberculosis sputum positive on admission Artificial pneumothorax right instituted and discontinued in 5



months because of apical adhesions Extrapleural pneumothorax established April 28 1938 Sputum positive through May 1938 Phrenic paralysis done June 13, 1938 Sputum negative since condition excellent Roentgenograms taken April 20 1938 and November 16 1938



Fig. 1. Case No. 43160. T. K. white male age 27 years. Admitted to Municipal Tubercular Sanitarium January 2, 1935. Diagnosis: far advanced pulmonary tuberculosis. Sputum positive on admission. Extrapleural



pneumothorax established June 30, 1935. Sputum negative since patient in excellent condition discharged December 2, 1935. Roentgenogram taken April 26, 1935 and July 2, 1935.

between the external surface of the parietal pleura and the endothoracic fascia is established. Stripping in this plane is continued over the apex much in the manner of the Serrula apicolysis and then continued downward toward the diaphragm as far as seems indicated in the individual case. Complete hemostasis is most important. We have relied largely on hot moist packing but occasionally ligation or coagulation were necessary.

Next the wound is tightly closed with a suture approximating the adjacent ribs. We have partially filled the artificially established cavity with saline believing it will inhibit the formation of blood clots and facilitate future aspirations.

A combination of intrapleural and extrapleural pneumothorax may be feasible. Sellors suggests that this can be done in 4 different ways: (1) the 2 spaces can be maintained separately; (2) a communication can be made at the time of operation; (3) a communication can be established later with the aid of the thoracoscope; and (4) the extrapleural stripping of the apex can be made through the pneumothorax space much as in intrapleural pneumothorax.

Sauer reports 11 cases of bilateral extrapleural pneumothorax. We have used the operation in combination with contralateral collapse by pneumothorax and by thoracoplasty.

POSTOPERATIVE CARE

The immediate postoperative course has been mild in all of our cases except one and recovery uneventful. In the one case there seemed to be a state of shock from some unexplainable cause from which the patient recovered rapidly after the second day. The inevitable accumulation of bloody fluid is removed in 24 hours and replaced with air. This maneuver is repeated as indicated at periodic intervals. We believe it of extreme importance to keep the space free of fluid. The space seems easily maintained; there is little tendency for the air to escape and there has been very little subcutaneous emphysema in our cases. We have given refills at weekly intervals the amount of air absorbed being 100 to 400 cubic centimeters in that interval. We have maintained positive pressures as high as 20 to 40 centimeters of water to retard the gradual process of obliteration of the space which we have observed in some cases. Collapse should be continued if possible as long as in a comparable case of intrapleural pneumothorax.

COMPLICATIONS

Complications such as hemorrhage, infection and perforation of the lung have been encountered.

tered or suggested. Overholt and Tubbs report 4 infected spaces in 31 operations, 3 with bronchial fistulas.

Roberts reports 3 deaths, 1 from hemorrhage in 33 cases. Brock reports 5 deaths in 50 cases.

The only immediate difficulty we have experienced was the 1 postoperative reaction already mentioned and best described as shock. One patient developed a simple tuberculous empyema but this apparently has been controlled completely with the aid of oleothorax. Another patient developed an alarming pulmonary hemorrhage following aspiration but recovered with no ill effects. Two of our patients have developed a low grade non specific infection in the extrapleural space. One has been controlled completely by repeated aspirations and irrigation and the other seems virtually controlled. In the only case in which we have combined intrapleural and extrapleural pneumothorax the space became infected 2 months after the operation and is still being aspirated. We have had no deaths and no instances of spread of the tuberculous disease to the other lung or other parts of the body. Progressive obliteration of the space will probably follow slowly in most cases but as yet this has not threatened the effectiveness of the collapse in our otherwise successful cases.

RESULTS

The end results in tuberculous cases cannot be determined for many years. However, the immediate results have been very encouraging and on the basis of experiences with other collapse measures we would predict that most of the favorable effects will be permanent.

Of the 22 patients operated upon 14 have what appears to be an adequate collapse with closure

of cavities and negative sputum. Five others have a good collapse but remain positive. In 3 patients the collapse appears inadequate and will be or has been discontinued.

CONCLUSIONS

1. Extrapleural pneumothorax will undoubtedly prove to be a valuable collapse measure.
2. A posterior approach with resection of the fourth rib seems to be most practical.
3. Careful technique and a faithful postoperative management are most important for success.
4. The exact possibilities and limitations of the operation are still to be determined.

REFERENCES

1. BLISEN R. Extrapleural pneumothorax. *J Thoracic Surg* 1938, 7: 575.
2. BROCK R. C. Extrapleural pneumothorax. *Brit J Tuberc* 1938 32: 173.
3. CLAP W. Aspects of new methods of surgical collapse in pulmonary tuberculosis: extrapleural selective pneumothorax and oleothorax. *Deutsche med Wchnschr* 1937 63: 4.
4. MONOD O. Technic indications and maintenance of extrapleural pneumothorax. *J Thoracic Surg*, 1938 8: 150.
5. OVERHOLT R. H. and TUBBS O. S. Extrapleural pneumothorax in the treatment of pulmonary tuberculosis. *J Thoracic Surg* 1938 7: 501.
6. RHODES B. Pneumolysis combined with extrapleural pneumothorax and oleothorax. *Lancet* 1937 233: 377.
7. ROBERTS J. F. H. Extrapleural pneumothorax. *Brit J Tuberc* 1938 32: 68.
8. SAGER C. Bilateral extrapleural pneumothorax. *Ztschr f Tuberk* 1938 80: 217.
9. SCHMIDT M. Extrapleural pneumothorax. *Rev de la tuberculose* 1937 3: 1122.
10. SELLORS T. H. Extrapleural pneumothorax. *Brit J Tuberc* 1938 32: 182.
11. TUFFIER T. Etat actuel de la chirurgie intrathoracique. Pp 90-103, 163-172. Paris: Masson et Cie 1914.

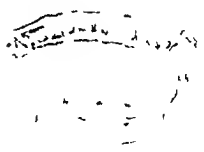




Fig 1

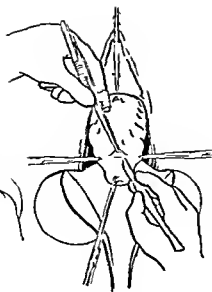


Fig 2



Fig 3

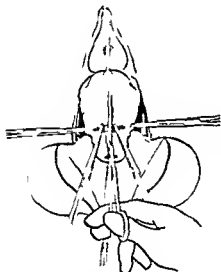


Fig 4

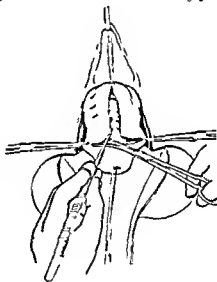


Fig 5a

Fig 1. Dilate the cervix. The cervix is dilated to a No. 12 Hegar. This step helps in the insertion of the sutures in the cervical canal during the fashioning of the new cervix. A curettage is done if malignancy is suspected. A vaginal hysterectomy can be done if cancer is found. Vaginal hysterectomy is one method of treating prolapse.

Fig 2. Applying the "three forceps." A pair of Kocher forceps is applied laterally and these are known as Fothergill's points. Their exact position varies with the degree of prolapse, size of the cervix, etc. They should be at the level or slightly below the level of the internal os. The points of the forceps should just meet when they are approximated in front of the cervix. A third forceps is applied

in the midline, usually about 1 inch down from the urinary meatus. The area between Fothergill's points is now picked up with a dissecting forceps and incised.

Fig 3. Dissecting the anterior vaginal wall from the bladder. A pair of curved scissors is now gently inserted through the incised wound and pushed upward, dissecting as shown the bladder off the anterior vaginal wall.

Fig 4. Incising anterior vaginal wall. A pair of Kocher forceps applied to the cut edge makes excellent traction and the vaginal wall is incised to the third forceps with care not to wound bladder and lower part of urethra.

Fig 5a. Lengthening transverse incision. Incision started in Figure 2 is carried laterally to Fothergill's points.

THE TREATMENT OF UTERINE PROLAPSE

H W JOHNSTON, M D F R C S, Toronto Canada

UTERINE prolapse is a purely vaginal occurrence. Before proceeding to any particular operation designed for its relief, it is wise that we consider carefully a few anatomical facts. The supporting mechanism of the genital tube and its contents is made up of two diaphragms. The upper diaphragm consists of the two cardinal ligaments. These comprise the parametra, the two uterosacral ligaments or folds, the condensation of connective tissue at the bladder neck, at the vaginal vault, and at the lateral sides of the vagina. These masses of connective tissue resemble a fan. They extend outward and are attached to the side walls of the pelvis. The lower parts of the cardinal ligaments can be especially well seen during the dissection in the radical operation for malignant disease of the cervix. Their importance in maintaining the uterus in its normal anatomical position is incontestable. Prolapse of the uterus and vaginal vault is impossible with healthy, intact, and well supported cardinal ligaments.

The bladder rests upon, and is supported by, a musculofascial sheet the uteropubic fascia. The term describes its attachments. When this sheet is torn or stretched, a cystocele results. A similar sheet extends along the posterior vaginal wall. It supports the rectum. A rectocele follows when it is damaged.

The lower diaphragm is called the pelvic floor. The structures forming the pelvic floor from within outward are:

- 1 The pelvic diaphragm
 - a Peritoneum
 - b Levator ani muscles with their fascias above and below
- 2 The urogenital triangle
 - a The two layers of the triangular ligament with the sphincter urethra muscle
 - b The crura of the clitoris and the bulb (sphincter vaginae)
 - c The superficial muscles of the perineum
 - d Colles' fascia, fat, skin (see Figure 5b)

The levator ani and coccygeal muscles form one sheet. This sheet is thrice perforated in the midline by the urethra, vagina and rectum. These tubes are surrounded by muscle fibers and connective tissue from this muscle sheet. Injury from childbirth to this complicated supporting mechanism or atony of the pelvic diaphragm mus-

cles with their associated fascias above and below leads to prolapse.

Uterine prolapse is complete or incomplete with all sorts of degrees and variations in between. In a number of prolapse cases, a cystocele is present, in others, the bladder descent is negligible. Most have a deficient perineum, a few have not. In others, a small cul de sac, hernia of Douglas's pouch is present and one should be ever on the alert, for such a hernia. Failure to recognize this condition when operating for uterine prolapse will cause the patient a great deal of disappointment when she finds that another operation is necessary to correct it.

There is no branch of surgery in which the ingenuity of the surgeon is so taxed as in the field of constructive gynecology. Anyone who adopts one line of procedure to the complete exclusion of all others—well he hasn't stopped to think.

For the aged, with minor degrees of uterine descent and a cystocele, the interposition opera-

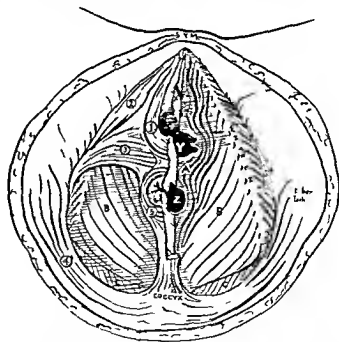


Fig. 5b A bisected pelvic floor showing the superficial and deep structures. 1 Urethra 2 vagina 3 rectum 4 Pubococcygeus 5 iliococcygeus 6 Liliococcygeus (coccygeus in man) comprising the levator ani muscle 7, sphincter urethra muscle 8 The bulb or sphincter vaginae 9 the crura of the clitoris 10 the superficial perineal muscle 11 the gluteus maximus muscle 12 the sphincter ani muscle

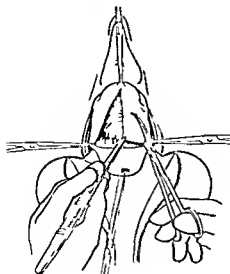


Fig 6

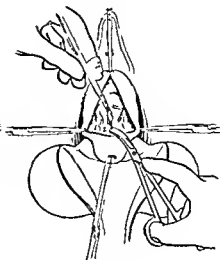


Fig 7

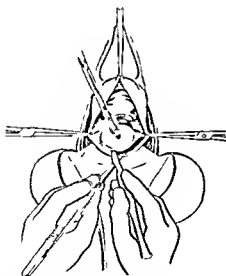


Fig 8

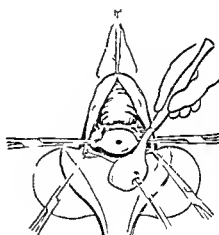


Fig 9

Fig 6 Excising part of the anterior vaginal wall. The triangular area of mucous membrane situated between the three forceps is now dissected free from the bladder wall and removed.

Fig 7 Dissecting the bladder from the cervix. This is best done with scissors supplemented by pressure from the gauze covered finger after the first attachment of the cervix to the bladder has been cut away. The lower limits of the bladder can be easily felt with the gloved fingers—the bladder then picked up with a dissecting forceps and the first part of the dissection started with scissors. It is of the utmost importance that the bladder be freed well from the sides and front of the cervix and pushed well up until the uterovesical pouch is reached. Failure to observe this warning may result in ureteral and bladder damage during the

introduction of the sutures (see Fig 14). If hemorrhage ensues the bleeding points should be carefully clamped and tied with No. 1 plain gut.

Fig 8 Incising the posterior vaginal wall. A transverse incision is now made between Fothergill's points behind the cervix. The incision is deepened to the cervix posteriorly and a flap of vaginal wall is raised up.

Fig 9 Clamping the parametra, dividing it and amputating the cervix. The bladder should be pushed well up before the two Kocher forceps are applied. They include in their bite the lateral cervical vessels. The tips of the forceps should nip the side of the cervix. Failure to attend to this may result in a lot of troublesome bleeding after the cervix has been amputated. The cervix is amputated by simple transverse incision.



Fig. 10

Fig 10 Tying the vessels Reverdin's needle should be made to grasp a small piece of the cervix so anchoring the ligature

Fig 11 The posterior infolding suture The posterior flap is pulled down and Reverdin's needle is passed as shown so that when withdrawn fully threaded the infolding suture is formed It gives a much superior and firmer apex to the flap than if the needle were only made to penetrate the flap the once

Fig 12 Fashioning the cervix posteriorly The posterior infolding suture has now been tied once at the apex of the flap to make the suture immovable during the turning in of the flap Reverdin's needle is passed made to penetrate the posterior vaginal wall the posterior part of the cervix and emerge in the cervical canal It is now threaded with one of the free ends of the suture attached to the apex of the flap and withdrawn The procedure is repeated—the remaining part of the suture grasped in the eye of the needle and again withdrawn

Fig 13a Tying and cutting the posterior infolding suture On tying the two ends of the suture the posterior flap of mucous membrane is now brought firmly against the cut edge of the cervix The apex of the flap is firmly anchored in the cervical canal

Fig 13b Inserting the encircling sutures One of the dangers in any operation involving the cervix is oozing—troublesome oozing If it persists after the posterior infolding suture has been tied I often insert two encircling sutures Reverdin's needle is passed from the cervical canal directed outward and lateralward traversing the cervix and made to penetrate the posterior vaginal wall lateral to the posterior infolding suture It is then threaded withdrawn and tied The same procedure is repeated on the corresponding side The insertion of these sutures is not carried out as a routine Careful attention to the securing and ligaturing of the cervical vessels makes it rarely necessary (see Figs 9 and 10) However careful some cervixes are very vascular and a number of vaginal flaps ooze excessively It is in such a case the encircling suture is employed to good effect

Fig 14 Inserting a modified Fothergill's suture This suture starting at Fothergill's point on one side passes through the vaginal mucous membrane—the parametrium—an area of the lower uterine segment just above the internal os—the parametrium of the opposite side and the mucous

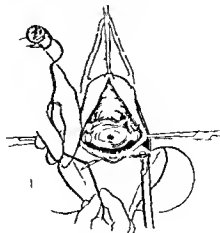


Fig 11



Fig 12

tion is useful Vaginal hysterectomy by the method of Mayo is very good if the uterus needs removing at the same time For the old and feeble and in those in whom the question of further coitus can be forever answered in the negative, LeFort's operation is recommended The Fothergill operation is a very useful one If a cystocele is present, it can be repaired at the same time Frequently, there is a cystocele All operations for vaginal or uterine prolapse are incomplete without a perineorrhaphy A perineorrhaphy should always be done

A series of descriptive drawings showing an operation for uterine prolapse is presented The principles are those of Fothergill The technique—that of fashioning the cervix and introducing Fothergill's suture—is different I would like to take this opportunity of acknowledging my indebtedness to this brilliant British gynecological surgeon

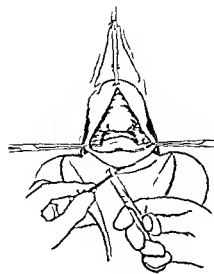


Fig. 14

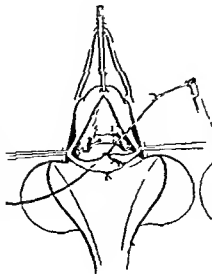


Fig. 15



Fig. 16

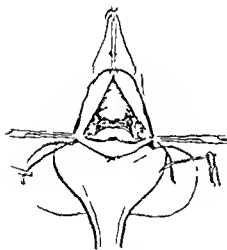


Fig. 17

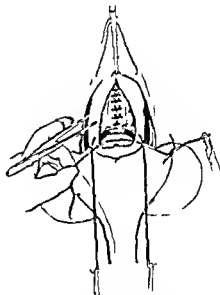


Fig. 18

membrane emerging at Fothergill's point of the opposite side.

Fig. 15. Repairing the cystocele. Interrupted sutures draw together the torn or stretched pubocervical layer of pelvic fascia. In the regular repair of the cystocele the final suture passes through the supravaginal cervix so that when tied the bladder is entirely shut off from below. This suture is purposely omitted in this operation. It would draw the cervix too far forward when tied. When Fothergill's suture is tied later on the small opening between the supravaginal cervix and the last pubocervical suture will be covered and plugged with parametra and paracervical tissue.

Fig. 16. Inserting the anterior flap suture. Reverdin's needle is now passed through the mucous membrane of the anterior vaginal wall in two places at distances of approximately 1 inch from the apex of the newly formed posterior

flap (see Figure 12). These points of necessity will vary with the size of the cervical stump to be covered, i.e., a large stump requiring more mucous membrane and consequently the suture points would be further out. With a little ingenuity on the part of the operator the flap can easily be formed.

Fig. 17. Approximating the two anterior flaps and tying a knot. The anterior vaginal wall flaps have been brought together and the suture tied with one knot so as to make it immovable during the next step of turning in the flap.

Fig. 18. Fashioning the cervix anteriorly. Reverdin's needle is now passed through the anterior part of the cervix into the canal, one of the sutures inserted in the eye of the needle and withdrawn. The needle is reinserted the

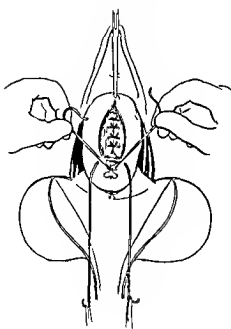


Fig 17

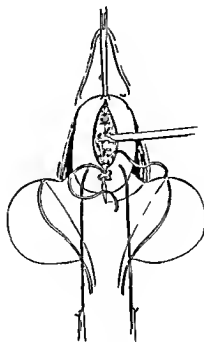


Fig 18

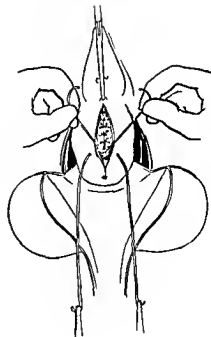


Fig 19

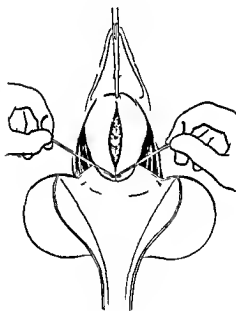


Fig 20

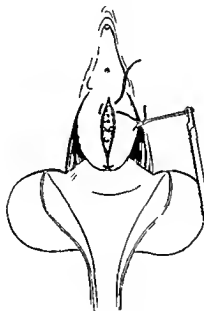


Fig 21

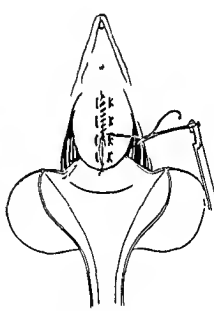


Fig 22

other suture grasped in the eye and the needle withdrawn. A tenaculum applied to the anterior lip of the amputated cervix steadies it during this procedure and keeps the modified Fothergill's suture well forward.

Fig 19 Tying the anterior infolding suture. When the ends are drawn taut and tied the anterior flaps roll in—cover up the anterior part of the cervix—and complete the fashioning of the cervical canal.

Fig 20 Tying the modified Fothergill's suture. In this way Fothergill's points are united in front of the cervix and as mentioned before in Figure 15 the parametra being approximated in front of the cervix the hernial orifice between the last suture in the pubocervical fascia and the supravaginal cervix is closed. The bladder also is firmly supported. Particular reference was made in the introduction of the modified Fothergill's suture that the suture be

inserted into the uterus above the region of the internal os or what I choose to call the pivotal point so that now when tied tightly the cervix is forced backward and the body of the uterus is drawn forward thus correcting any tendency to retroversion of the uterus.

Fig 21 Inserting a series of mattress sutures. These sutures are hemostatic roll the edges out nicely and when inserted far back take in their bite a few fibers of the uteropubic musculofascial sheet so forming an additional barrier against any further bladder descent.

Fig 22 Suturing the cut edge of the vaginal wall. This is quickly done with a continuous suture.

Fig 23 A perineorrhaphy should be performed also. The author uses a knife entirely for this dissection. The field of operation is exposed by grasping with two Kocher forceps that part of the introitus close to the lowest carun-

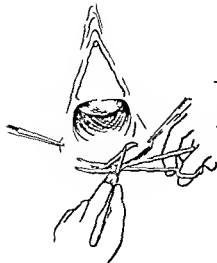


Fig. 23



Fig. 24

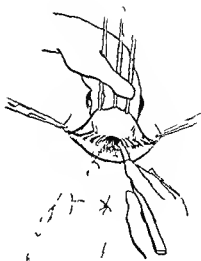


Fig. 25

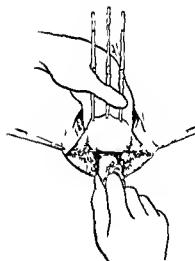


Fig. 26



Fig. 27

culæ myrtiliformes on each side of the vagina. This is usually exactly below the opening of Bartholin's gland. Traction is made in an outward direction on these two forceps and the mucocutaneous junction is now incised with scissors.

Fig. 24 Beginning the separation of the posterior vaginal wall. Three Kocher forceps are now applied to the upper part of the newly made incision, held with the left hand, and the knife is used to dissect up the flap. This can be done rapidly and safely as the pulp of the fingers of the left hand pressed firmly against the flap guides the knife in its course and makes the dissection safe.

Fig. 25 Incising the scar tissue and the superficial structures of the perineum. With the flap raised and protected as before by the fingers of the left hand, the dissection is carried deep in and further out to the sides. Colles fascial fibers of the superficial transversus perinei muscle and

the scar tissue brought about by previous tears and lacerations from child birth are severed until deep in the central part of the perineum the rectal wall can be seen. The knife changed from one side to the other works admirably.

Fig. 26 Separating further the posterior vaginal wall by the gauze covered finger and isolating the levator ani muscle straps. The cellular area between the rectum and vagina separates easily—finger dissection being bloodless. The pubococcygeal straps of the levator ani muscles now are identified. They are not at all superficial as many surgeons think, but lie deep and far out in the perineum. The absolute isolation of this musculofascial structure is essential if a good result is anticipated.

Fig. 27 Removing the redundant vaginal mucosa. The amount of mucous membrane to be removed varies in every individual case. If the question of further coitus can be answered in the negative a considerable amount may be cut away. If not, then it is most important that great care be taken to avoid a vaginal stricture. It is much wiser and safer to err in leaving too much rather than too little. Usually in this type of operation for vault and uterine prolapse the apex of the flap has to be carried quite high in the vault of the vagina. When this point has been decided upon a Kocher forceps is applied to denote the upper margin of the flap and the redundant mucosa is then cut away with scissors.

Fig. 28 Uniting the cut edges of the posterior vaginal wall. The dissection having been finished Reverdin's needle is now passed at the apex threaded withdrawn and the suture tied. Sometimes it is wise to insert the needle again, pass the short end of the tied suture through its eye withdrawn and re-tie. This double knot makes for safety. The short end is then held up with a Kocher forceps and the suturing continued part way down the vaginal walls. The

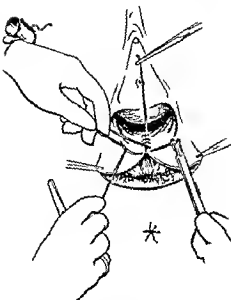


Fig 28

Kocher forceps hold the short end is then cut away and now transferred to the long end of the suture and held taut.

Fig 29. Approximating the levator ani muscles. With the pulp of the index finger of the left hand pressing the rectum well back a series of sutures are inserted joining together the two levator straps. It is well after tying the first suture to make a vaginal examination. The vagina should admit two fingers easily. If on examination the canal is unduly narrowed the suture should be removed and a suitable one inserted. It is well if at all possible for the top suture to include with it some of the loose tissue on the posterior vaginal flap. This obliterates the dead space and tends to control hemorrhage. Three or 4 sutures usually suffice to establish a firm pelvic floor. The sutures should be firmly tied the top most with 3 knots.



Fig 29

Fig 30. Completing the approximation of the cut edges of the vaginal wall. The continuous suture held by the Kocher forceps (Fig 28) is now further used to bring together the cut edges of the posterior vaginal wall so fashioning the newly formed vaginal tube. When the skin margin is reached the suture is tied.

Fig 31. Suturing the superficial structures of the perineum. A few interrupted sutures bring together the fibers of the superficial transverse perineal Colles fascia and superficial fascia. The sutures should be firmly tied with two knots and the ends cut short to avoid catgut knot serum in the perineal wound.

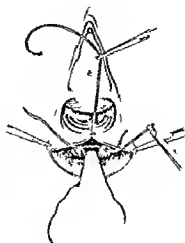


Fig 30

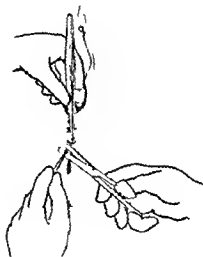


Fig 31



Fig 32



Fig 33

Fig 32. Closing the wound. Interrupted catgut sutures are used. Particular care should be exercised during this final maneuver to see that the skin edges are well everted. The surgeon with a dissecting forceps everts the edges well while the assistant ties the knot.

Fig 33. The final suture.

The writer wishes to convey his appreciation to the ever inventive genius Mr. Victor Bonney. The worst retractor containing the catgut is his also the modification of Reverdin's needle. The small scissors are my modification of the Kocher scissors and the dissecting forceps is my own. The forceps is quite useful when used with Reverdin's needle and where the problem of fat is ever to the fore. The thumb prevents slipping exerts a steadying influence on the forceps when the surgeon is working in difficult corners and moreover does not impair the usefulness of the left hand as can be seen in the sketches of the operation (Fig. 10). The modified Kocher scissors carried by the assistant on the fifth finger of his right hand are also useful. They are always to hand when the cutting of sutures or ligatures is desired and do not impair his usefulness nor does a good assistant find them cumbersome. Quite the reverse very handy. The material used throughout is chromic No. 2 gut except for small sutures catgut when No. 1 plain is employed.

AN IMPROVED INCISION FOR THE RADICAL OPERATION FOR CARCINOMA OF THE BREAST

NEIL JOHN MACLEAN M.D. M.R.C.S. F.A.C.S., F.R.C.S. (Can.) Winnipeg, Canada

THE ideal incision for cancer of the breast should provide for the removal of a wide area of skin over the tumor including the nipple and the areola while at the same time it should allow for closure of the wound without undue tension on the skin flaps. This should be possible in all early cases without the danger of sloughing from tension while in more advanced cases so large an area of skin must be sacrificed that skin grafting will be necessary no matter what type of incision is used. The incision herein described which I have used for several years allows of more adequate removal of skin with better closure thereby reducing to the minimum sloughing and the necessity for skin grafting.

The skin over the pectoralis major muscle is quite tense and unyielding and does not lend itself well to plastic closure. However the skin below the pectoralis major and over the axilla is more pliable and quite freely movable in a horizontal or anteroposterior direction but not so freely movable in the vertical direction. In closing the elliptical incision the one most commonly used it is often found that there is undue tension in the center of the incision or the flaps entirely fail to come together, while at the same time the lower flap is quite loose and has abundant tissue and to spare in the direction parallel to the incision as depicted diagrammatically in Figure 1.

The principle of the incision to be described is to take advantage of this laxity in the lower flap in such a way as to bring the central points of the flaps closer together and thus allow adequate closure with little or no undue tension as distinct from the incisions which depend for closure on the mobility of the skin in a direction at right angles to the incision.

In the elliptical incision the central points (Fig. 2 A and B) usually will not meet or do so with difficulty and tension.

The upper flap is formed in the usual manner. The lower flap however is made by two incisions forming a V which includes the skin over the tumor, the nipple and areola (Fig. 3).

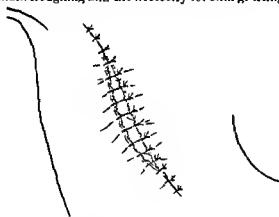


Fig. 1 Tension on flaps when sewn in a straight line

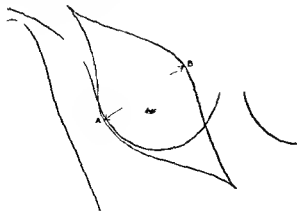


Fig. 2 Points of maximum tension A and B

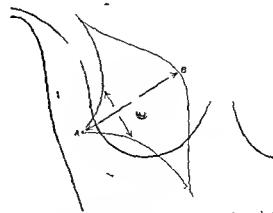


Fig. 3 Author's modification of the incision V making the lower flap V shaped

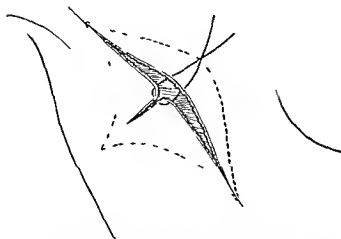
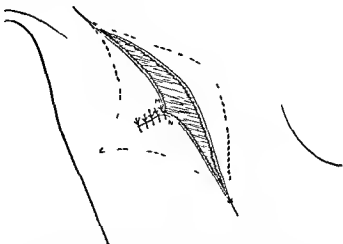


Fig 4 A Closure beginning with a U stitch

Fig 4 B Method of sewing up starting at point of V



and taking in the slack with sutures thus advancing the central point of the lower toward the upper flap



Fig 5 The closed incision which is now T shaped

In closing the incision the two sides of the V come together readily. A point in the upper flap is selected to which two points on the lower flap will meet without undue tension. These three points are conveniently anchored by a U stitch (Fig 4, A). Closure may begin at the point a closing in the V until the lower flap will meet the upper without tension, (Fig 4 B) and stopping before lateral tension begins. The upper angles of these two flaps should be rounded off to minimize the danger of sloughing.

The closed incision is now T shaped (Fig 5).

The site of the tumor and its relation to the nipple necessarily require consideration in the placing of the incision (Figure 6 illustrates these variations).

It is essential to know the lymph drainage of the breast and the way in which malignancy spreads in order to place the incision to insure removal of all possible involvement beyond the primary growth. Skin involvement and skin nodules (following operation) are only some of the

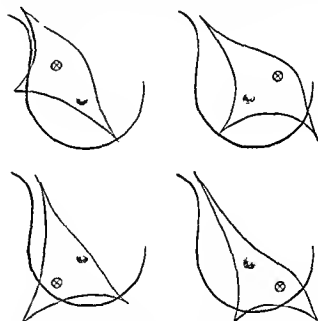


Fig 6 The method of placing the incision according to the location of the tumor

problems of the surgery of malignant disease of the breast. The scope of this paper cannot take these into consideration.

RESUME

1 Difficulty is often encountered in closure when an adequate skin area is removed with an incision of the elliptical type.

2 The incision described herein allows of equally free removal of skin in suitable cases and closure is simplified.

3 Skin grafting is less frequently necessary.

4 It is understood that closure of the wound is not the essential consideration when malignant growth is very extensive or has already involved the skin.

MALIGNANT MIXED TUMORS—ADENOSARCOMA OF THE CORPUS UTERI

LAWRENCE SOPHAN, A B M D New York New York

THI group of cases under consideration appears to be uniform in 3 respects postmenopausal incidence, composite histology and high malignancy. These cases are therefore sharply separable from the whole group of sarcomas of the uterus which occur at all ages and are variable in histological features and in degree of malignancy and curability. Whether adenosarcomas have been hitherto grouped together with other sarcomas of the uterine corpus in the reported studies is not possible to determine. In the group of 40 sarcomas reported by Handley and Hawkins the ages ranged from 30 to 70 and the authors found a correlation between frequency of mitotic figures and fatal outcome. They were satisfied that it was practicable to distinguish cellular but benign fibromyomas from sarcoma by the preservation of the whorled pattern in the former as well as the lesser number of mitotic divisions. In the absence of any statement as to the menstrual status of their patients I have noted that if the cases are grouped according to age the 17 patients below the age of 50 show a group of 7 surviving the period of observation while in the group of 23 above the age of 50 only 1 survivor is found. However there is no evidence that any of these cases showed the composite histology found in my group.

A study of a large group of uterine sarcomas by Novak and Anderson includes only 2 cases of polypoid sarcoma or sarcoma botryoides both occurring in young children and rapidly fatal. The authors believe that sarcoma may arise from the uterine wall or from a fibromyoma both of these sources furnishing myogenic tumors and other sarcomas may arise from the mucosa presumably the stroma cells and from blood vessels. They found that the tumors of fibromyomatous origin yielded the most numerous clinical cures but that in general the degree of mitotic activity was a good guide to prognosis. No mention of composite structure or of the comparative outcome of cases beyond the menopause is made.

Six cases constitute the group presented here. They were found among a total of approximately 8,500 gynecological specimens obtained in a period of 9 years. This is about one third the

incidence of all uterine sarcomas found by Novak and Anderson. All the cases presented similar clinical features: discharge, hemorrhage, passage of clots and slough, irregular pain, soreness and feeling of pelvic weight. All had passed through the menopause 2 or more years before the onset of symptoms. Physical examination revealed palpable enlargement of the fundus and in some cases a mass partly extruding itself through the dilated cervix. This mass was usually smooth and its surface was edematous and hemorrhagic so that the clinical impression of a degenerating submucous fibromyoma was given. Examination of slough or of a biopsy specimen was necessary for diagnosis.

The clinical course and pathological findings in the individual cases follow.

CASE 1. A single nulliparous Swedish woman of 31 years, as seen first as a clinic patient. She had reached the menopause 2 years before the present illness. Four weeks prior to coming to the hospital she had occasional painful sensations in the lower abdomen followed shortly by the passage of blood and 1 blood clot. The hemorrhage became progressively worse and 6 to 12 pads a day were required. She had noted a yellow, fish-odorless discharge before the bleeding but could not fix its time of onset.

Physical examination detected a moderate, poorly outlined enlargement of the fundus of the uterus. The cervical canal was patulous and bleeding, and there was a suggestion of a mass extruding itself at the internal os.

Operation on August 15, 1936, disclosed a large amount of friable material of the type usually described as cauliflower. The fundus could be felt under one thumb to be about three times its normal size. A biopsy revealed the characteristic histopathology of adenosarcoma (Fig. 1). Very irregular tubular structures of epithelial appearance were found widely separated in a pleomorphic stroma. The tubules showed their lining cells poorly oriented with small secondary acini in the walls of the larger ones. Mitotic figures were more numerous in the supporting stroma where the cells were large and frequently of giant form with several nuclei. There were some cells with acidophilic cytoplasm resembling smooth muscle cells but greatly enlarged and with hyperchromatic and multiple nuclei.

The patient was treated by the insertion of radium in the uterine canal for a total dosage of 2,500 milligram hours. She was thought to be too anemic for further treatment and was discharged. Subsequently she was given a course of pelvic x-ray therapy at 4 ports. Readmission on January 17, 1937, found her somewhat improved with the hemorrhage reduced to occasional spotting. The fundus was about three times its normal size and the cervix was very small and shrunken. Laparotomy on January 19, 1937, revealed multiple peritoneal adhesions



Fig 1 Case 1 Curettage specimen shows one large and other small tubular groups of ill differentiated epithelium with sarcomatous stroma of polymorphous variety but including many large acidophilic cells apparently immature muscle



Fig 2 Case 1 Biopsy of omentum has the structure of undifferentiated carcinoma without stroma

and metastatic nodules over the omentum and the surface of the liver. Both adnexa were found covered by new growth. A biopsy specimen of the omentum was taken but no therapeutic procedure was thought possible.

Pathological examination of the omental biopsy tissue brought out some features identical with and others dissimilar to the primary tumor. The cells (Fig 2) appeared to be of a single type and resembled anaplastic carcinoma in their tendency to group themselves in close apposition without tubular arrangement. Spindle forms resembling the stromal masses in the first biopsy were numerous but none of the myoblasts could be found.

This patient continued to become more feeble and had attacks of abdominal pain. She died 14 months after her first admission with evidence of widespread metastases.

CASE 2. A 58 year old colored woman nulliparous 9 years past the menopause came for the relief of symptoms which began about 2 years before. The principal complaints were vaginal staining partly watery and pink and sometimes bloody and increasing abdominal tumor. She also had backache, rectal pain, frequency, pain in urination and bilateral abdominal soreness. Physical examination revealed an enlargement and induration of the uterine fundus with fixation. The cervical lips were smooth but the canal was dilated with necrotic material protruding from it. The right adnexa felt indurated and enlarged. Operation on May 11, 1937 revealed a polypoid mass in the uterine cavity and this was avulsed. It proved to be an ovoid solid mass 7.7 by 5 by 4.5 centimeters. Its surface was brown and almost smooth but the consistency was friable. On section the tissue appeared soft and spongy with many large foci of hemorrhage but no cavities.

The histopathology of this tumor (Fig 3) is composite. The predominant cell form is a spindle shaped structure with poorly defined cytoplasm and ovoid clear nucleus. Scattered large cells with acidophilic cytoplasm and hyperchromatic nuclei are present. In the densest foci there are cords of large anaplastic cells. Many foci are myxomatous with smooth basophilic intercellular substance of chondroid type.

This patient was considered to be too cachectic to undergo any treatment. She died of abdominal tumor extension 5 months after admission.

CASE 3. A 58 year old white married woman passed a large mass per vaginam and subsequently continued to bleed. She had passed the menopause about 5 years before and although the present illness had been preceded



Fig 3 Case 2 An undifferentiated ground structure of small spindle cells scattered among which are large cells (myoblasts) seen especially near the vessels and other cells with giant nuclei



Fig. 4. Case 3. In this field are seen solid and tubular nests of carcinoma with a very cellular stroma containing undifferentiated spindle cells and large acidophilic cells which show occasional markings resembling striations.



Fig. 5. Case 4. The above curette specimen illustrates a striking admixture of cellular stroma with myxomatous foci, islands of cartilage and epithelial tubules of irregular form.

by abdominal fulness and fatigue she had not called for medical attention. She probably had had a vaginal discharge for some time but no frank hemorrhage until the sudden protrusion and subsequent passage of the mass. Examination of the specimen showed it to be 12 by 10 by 5 centimeters with a smooth brown surface broken at one end by a pointed hemorrhagic zone representing apparently the site of attachment. On section all of the tissue was soft and solid with a mixed gray brown and red streaked color and a fibrous texture.

Microscopic examination (Fig. 4) shows a composite histology. The supporting tissue is made up of spindle cells which are elongated and separated by clear non-fibrillary material. Among the cells are a great many larger ones which have abundant acidophilic cytoplasm and central nuclei showing hyperchromatism and scattered mitotic figures. Tubular glands are embedded in this mixed stroma and consist of poorly oriented epithelial cells with clear cytoplasm, sharp cell borders and irregular nuclei. Many solid clusters of the epithelial cells are observed.

Laparotomy was performed in an attempt to remove the uterus and adnexal structures but adhesions and tumor implantations were encountered over the urinary bladder and on the anterior abdominal wall. Biopsy of the mass revealed a marked predominance of poorly organized adenocarcinoma without the composite structure found in the uterine mass.

This patient died within 2 weeks in a sudden episode which had the clinical features of pulmonary embolism.

CASE 4. This patient is presented by permission of her doctor Dr. W. I. Healy of whose complete record the following is an abstract. Her present complaints began 12 years after the cessation of menses when she was 63 years old. She had been seen frequently for many years because of uterine malposition and menopause as induced at the age of 51 by intra uterine radium application of 1000

milligram hours. At the same time the cervix was cauterized and hysterectomy was done. She became free of symptoms and was well for 8 years under observation but ceased coming for periodic examination thereafter. She returned to Dr. Healy's observation 12 years after the last menstrual period with a complaint of a brownish vaginal discharge of 3 weeks duration. He found a zone of tenderness under the abdominal scar. The cervix was smooth with a large polyp protruding from the canal. The corpus was sensitive and enlarged to a size of about a 2½ months pregnancy. The polyp was a "wild"

The histopathology of this polyp (Fig. 5) is typical of the composite tumors in this group. There are large tubular and branching glands lined with one to three layers of oval epithelial cells poorly oriented in relation to the lumen and showing no secretory activity. The basement membrane is not well defined. In the stroma are noted occasional whorls of spindle cells of epithelial appearance with acidophilic cytoplasm and occasional intercellular bridges. The stroma itself is richly cellular and the cells are large, irregular and relatively deficient in intercellular fibrils. There are several striking foci of cartilage and other foci of myxomatous and chondroid appearance.

Treatment was instituted at once consisting of the intra uterine application of radium to a dosage of 3600 milligram hours and pelvic x-ray therapy, 1 cycle through 4 portals. After the elapse of 12 weeks a panhysterectomy was performed. At operation there was no evidence of tumor implantation or metastasis in the peritoneal cavity.

The gross appearance of the uterus was as follows. With the attached cervix it measured 7.5 centimeters in length and the fundus was 3.5 centimeters broad and 3.7 centimeters in depth. The wall on section was a fibrous and no nodules were to be felt or seen. The uterine canal showed a superficial zone of yellow cheesy opaque coagulation



Fig 6 Case 4. Operative specimen of the uterine wall after radiation therapy shows diffusely infiltrating tumor persisting in small strands but without the original characteristic differentiation.



Fig 7. Case 5. The complex architecture partly tubular adenocarcinoma and partly cellular stroma is seen to include in the latter many large acidophilic cells and several islands of cartilage.

occupying the place of the endometrium except at the top of the fundus where a pink smooth mucosa was present. In the middle of the uterine canal the coagulated cheesy zone involved some of the underlying myometrium to a depth of about 8 millimeters. The cervical canal was hemorrhagic and soft. The uterine tubes were of normal dimensions and fibrous consistency with a few fibrous adhesions. On section they contained a little clear fluid. The ovaries were both small wrinkled and fibrous on section.

Microscopic examination of the uterus (Fig 6) shows a number of unexpected features considering that the original tumor was polypoid and the gross appearance of the removed uterus gave evidence of radiation necrosis of the endometrium and fibrosis of the myometrium. Beneath the zone of typical hyalinization ischemia and coagulation of radiation necrosis are seen a great number of finely divided cell strands following the intramuscular vessels and penetrating into all parts of the sections. These strands consist of spindle cells and ovoid cells with basophilic cytoplasm and they are arranged in small clusters without acinar grouping. Some cells show hyaline globules. The uterine tubes and ovaries show no tumor involvement.

During the following year the patient continued under close observation and at the end of this period a mass became palpable to the left of the sacrum. Another complete course of x ray therapy was given and at the present time there is no longer a palpable mass nor any evidence of tumor elsewhere.

Cases 5 and 6 have been reported in a previous paper (12). Because of their identity with the cases above a summary of the clinical course and pathology is repeated here. The first case was observed in 1930 when the patient was 55 years old. She had had an artificial menopause induced by radium because of hemorrhage from fibroids (diagnosed clinically) she had had 4 children. After a period of 12 years of freedom from gynecological symptoms she entered the hospital complaining of backache and dysuria and examination revealed great enlargement of the uterus. Because abundant friable material was obtained at curettage complete abdominal hysterectomy was done.

The uterus was found enlarged and globular with a weight of 1030 grams. On section the corpus was seen distended by a pedunculated mass measuring 15 by 12 by 10 centimeters. Its surface was irregularly brown and red with some erosion. The cut surface was soft, fibrous and fatty with many small cysts and a great many focal hemorrhages and patches of necrosis. Microscopic examination (Fig 7) of this tumor mass revealed a composite histology with islands of gland forming epithelium resembling endometrial adenocarcinoma supported in myxomatous stroma where many large spindle cells and foci of cartilage were observed. A course of pelvic x ray treatments was given. Intestinal obstruction began to develop about 6 months after operation and continued to become more nearly complete until November 1931 about 14 months after operation when the patient died. The pelvis was indurated at this time but no autopsy inspection was permitted.

CASE 6 the second of the cases previously reported was observed by Dr W P Healy. This patient's symptoms began 9 years after a menopause induced by radium. She was 64 years old. Uterine hemorrhage began in June 1930 and continued until August. Their cessation appeared to result from a course of pelvic x ray therapy given in July and another course was given in September. A pelvic examination done under anesthesia in October demonstrated globular enlargement of the uterus and curettage was done. The fragments removed were necrotic. Failure of further radiation regression induced the surgeon to perform a complete hysterectomy on February 20 1931. The uterus was not heavy weighing 125 grams but there was a polypoid mass filling its cavity. Its surface was yellowish red and fungating. Section across the attachment showed no line of demarcation. No tumor could be found in the adnexa. Microscopic examination of the tumor showed a structure identical with the cases here reported with a striking admixture of spindle cell foci of sarcomatous appearance bearing large islands of cartilage. Large acidophilic cells resembling immature muscle were numerous. Many irregular tubular and solid epithelial clusters were present and could be demonstrated on the border of attachment of the tumor to the myometrium (Fig 8). This patient had



FIG. 8. Case 6. The composite structure found in this specimen is not shown here but the border between tumor and myometrium is invasive and there are tumor thrombi in the blood vessels.

an uneventful and almost symptom-free course for about a year and then developed pelvic and abdominal symptoms with clinical evidence of tumor recurrence and metastasis. She died about 2 years after the onset of symptoms and about 17 months after the operation.

SUMMARY OF CLINICAL OBSERVATIONS

The ages of the 6 patients at the time of the onset of symptoms were 52, 55, 58, 58, 63, and 64. The length of time past the menopause ranged from 1 to 12 years. The menopause had been natural in 3 cases and induced by radiation in the 3 others. The significance of the latter group is not apparent but because of the length of time with freedom from discharge or hemorrhage it does not seem possible that the tumor found later was responsible for the symptoms requiring the induction of artificial menopause. Five of the 6 patients complained mainly of discharge or hemorrhage and the other apparently noticed no abnormal flow. All were found to have smoothly enlarged uteri and a polypoid mass was detected on physical examination in 4 of the patients and was found in the 2 others when the uterus was sectioned.

In 3 patients complete hysterectomy was performed with pre-operative radium in 1 patient together with pelvic x-ray therapy and pre-operative x-ray therapy alone in another patient. The only patient showing some evidence of control of tumor growth was the former and this patient appears at present free of symptoms or

signs of tumor 18 months after the onset of her clinical course (Case 4). However the uterine sections showed diffuse infiltration of the myometrium by tumor after pre-operative radium and x-ray therapy.

The 3 patients not subjected to hysterectomy were in too advanced a state for the use of effective dosage of radiation although 2 of them had clinical complaints dating back 4 weeks or less. Biopsy of peritoneal or omental metastases was obtained in 2 of these patients and showed in them a predominance of the carcinomatous structure without the composite histology observed in the uterine tumors. However, these biopsies were so small that it is possible they did not furnish an opportunity for a complete study of the structure of the metastases. Evidence of pelvic or abdominal extension of tumor was noted at the time of the first laparotomy in 2 patients, became apparent in a short time in a patient not operated upon (Case 2), and developed in the 3 patients in whom hysterectomy was performed after intervals of 6, 1, and 10 months. In 1 patient (Case 4) it was possible to reduce the palpable pelvic tumor extension by x-ray therapy.

CASES REPORTED BY OTHERS

The variation in terminology is a serious handicap in identifying the group which is here called adenosarcoma. Under the influence of the similarity in histology of the congenital botryoid sarcoma these cases in adults have been reported in part as examples of the same disease. Other authors (4) have used the corresponding German term "traubiges Sarkom" but the cases so described appear to be characterized by the polypoid and lobulated structure only and consist entirely of examples of myosarcoma and polymorphous sarcoma of the endometrium. Such cases do not appear from the data given to constitute a group with any homogeneous characteristics as to clinical course or prognosis.

Two cases showing adenocarcinoma in a stroma of spindle cell and polymorphous sarcoma were reported by Rable Ruckhard in 1872 and their description corresponds with that of the present group. One woman was 51 years old and the tumor was noted 14 years after the occurrence of the menopause which must have been spontaneous although no information is given and the second case was that of a woman of 62 years who had passed the menopause 9 years before.

A case reported in 1890 by Klein was similar to the 2 above and the tumor was a polypoid mass in which a mixture of myxomatous and spindle cell sarcoma supported adenocarcinoma.

tous glandular elements. The patient was 39 years old and was 11 years past the menopause.

Mention is made by Opitz of 3 cases in which the composite structure here emphasized was found. He furnishes the clinical information that 1 case was in a woman of 57 years, who had passed through the menopause 6 years previously.

Von Franke makes mention of uterine polypoid tumors with a mixed structure of sarcoma and carcinoma, but furnishes no data as to age, relationship to menopause, or prognosis, except that 1 patient was 49 years old.

Robert Meyer describes 3 categories of uterine tumor which may belong to the group with which I am concerned. One category consists of cases he considers sarcomatous changes in polypoid adenomyoma. One case was that of a woman of 30 years and the other was a patient of 67 years. Both showed polymorphous sarcoma surrounding tubular glands lined by low columnar and cuboidal epithelium. In the latter tumor there also were nests of epidermoid epithelial cells. In Meyer's second group bearing on the present problem, there are described under the title "adenosarcoma" 3 cases of polypoid tumors arising from the uterine mucosa. Two showed mixtures of carcinomatous elements with the spindle cell stroma. A distinction from adenomyomatous sarcoma is made on the ground of the presence of hyperplastic smooth muscle in the former. Clinical data are not furnished. Thirdly, under the group of "carcinosarcomas," Meyer probably includes some cases which may belong to the group here discussed. He states that most numerous among the 51 cases of carcinosarcoma in the literature are the sarcomatous polyps, which are difficult to evaluate, since the surface or the glandular epithelium seldom is carcinomatous, or the cases refer to "polyps accidentally invaded by adjacent carcinoma."

Frank reported a case of mixed tumor occurring in the form of a very large polyp made up of spindle sarcoma and bearing irregular carcinomatous glandular structures. The age of the patient and the outcome of the case are not given.

Shaw collected from the literature 13 cases of mixed tumor arising in the corpus of the uterus. He included only those cases in which the histology revealed cells of "embryonic" type such as immature striated muscle, or tissues of atopic variety such as cartilage. No such case was to be found in the material at St. Bartholomew's but between 1870 and 1900 Shaw found reports of 13 cases meeting his criteria. One of these is von Franke's case, mentioned here. The ages of the patients were given in 7 of the reports as follows:

49, 50, 56, 58, 62, 62, and 73. The facts that whenever the information is available, the patients are beyond the menopause and a high malignancy and incurability of the condition exist, are particularly noted.

Wolfe reported a case which, in so far as it showed the presence of chondromatous as well as spindle cell and myxomatous structures, may be included in the present summary. The patient was 55 years old.

Frank mentions 2 cases of mixed tumor of the body of the uterus, 1 in a woman of 70 and the other in a woman "over 70." The structure was a mixture of carcinomatous glands, embryonal striped muscle, and epidermal surface epithelium. One patient died with metastases and in the other only the curettage specimen was obtained. Frank refers to another case as 'accidental mingling of adenocarcinoma and polymorphous cell sarcoma,' but clinical information about this patient is not furnished.

A summary of the reported cases coming into consideration shows, therefore, that 31 cases of tumors which may fairly be called malignant mixed tumors of the corpus uteri have been observed and that the age incidence is given in 16 of these and is in a range from 49 to 75 years with no occurrence before the menopause.

HISTOPATHOLOGICAL IDENTIFICATION

The malignant mixed tumors in the group here considered appear to arise from the endometrium. The characteristic intra uterine polypoid tumor supports this idea, as well as the usual intermixture of glandular inclusions or actual glandular and solid epithelial tumor components. However, following Shaw, I believe any uterine tumor showing multiple cell types and more particularly, myxomatous, myxomatous, and chondromatous differentiation should be included. It thus becomes difficult to exclude some of the polymorphous cell sarcomas, especially if endometrial glands may still be distinguished in the invaded tissue. In my cases, however, the presence of atopic tissue and particularly of immature muscle tumor cells has made it easily possible to distinguish the tumors from the polymorphous cell variety, in which the variety in appearance of the cells arises from the presence of round, spindle, and multinucleated forms without differentiation into characteristic structure.

The histogenesis of mixed tumors in the genital tract is commonly based on some variation of Cohnheim's theory of cell rests. Wilms used the same hypothesis to account for such tumors in the genital tract as he did for the renal tumors,

namely, the presence of an indifferent portion of embryonal mesoderm from the dorsal region which thus might include part of a myotome and account for the presence of striated muscle cells. Meyer refines this theory in believing that cell connections accidentally become established between the nephroblastema, the blastema of the pelvic wall and the wolffian duct and that the downward growth of the latter may thereby carry portions of the former tissues into the uterus cervix and vagina. These theories appear more comprehensible in the congenital and juvenile occurrence of mixed tumors. Recent experimental production of carcinoma of the uterus and cervix by estrogenic substances has been reported from a number of sources. In such work in rabbits Pierson produced by prolonged injection of folliculin in castrated animals an infiltrative tumor of carcinomatous appearance with metaplastic stroma in which islands of bone formation appeared. The fact that the mature endometrium has such potentialities may be related to the occurrence of mixed tumors without recourse to a hypothetical embryonal displacement.

CONCLUSIONS

1. A group of 6 cases is presented which is made up of examples of an unusual tumor type with a mixed structure occurring in the body of the uterus and characterized by the presence in the microscopic morphology of epithelial tubules, spindle cell sarcoma, myxomatous foci, islands of cartilage and immature muscle.

2. All of these cases occurred in patients past the menopause.

3. Of the 16 cases of similar pathological type reported in medical literature in which this information is given, all were postmenopausal.

4. The degree of malignancy is high and the differentiation from benign conditions particu-

larly submucous fibromyoma is important so that early treatment and operation may be instituted. Radiation appears to have some therapeutic effect, but complete abdominal hysterectomy is necessary because of the tendency to diffuse myometrial permeation. One case treated by both external radiation and intra uterine radium and subjected to hysterectomy has survived 18 months without clinical evidence of tumor at the end of that period.

REFERENCES

1. FRANK R. T. *Gynecological and Obstetrical Pathology*, 2d ed. pp. 246, 248, 249. New York & London: D. Appleton & Co. 1931.
2. FRANKL O. *Handbuch der gesamte Frauenheilkunde*, Vol. 2, p. 76. Leipzig: W. Liepman, 1914.
3. HANDLEY R. S. and HOWERS J. *Sarcoma of the uterus*. *Lancet* 1937, 2, 1180 and 1246.
4. KEITLER H. *Ueber traubenformige Sarcome in Corpus Uteri*. *Monatsschr. f. Geburtsh. u. Gynaek.* 1903, 18, 231.
5. KLEIN G. *Uterussarkom*. *Muenchen med. Wchnschr.* 1890, p. 10.
6. MEYER ROBERT. In *Zeit. Stoeckel's Handbuch der Gynaekologie*, 3d ed. vol. 6, pp. 661, 666, 731 and 773. Muenchen: J. F. Bergmann, 1930.
7. NOVAK E. and ANDERSON D. F. *Clinical and pathological study of sarcoma of the uterus*. *Am. J. Obst. & Gynec.* 1937, 34, 740.
8. OPITZ E. Quoted by Handley P. *Combined mixed tumors of female genitalia*. *Surg. Gynec. & Obst.* 1905, 1, 350.
9. PETERS H. *Metaplastische Knochen und Epitheloma nach Follikulin*. *Ztschr. f. Krebsforsch.* 1938, 47, 336.
10. RABLE RICHARD. *Beitrag z. Geburtsh. u. Gynaek.* 1872, 92, 191.
11. SHAW WILFRED J. *Obst. & Gynaec. Brit. Emp.* 1928, 35, 493.
12. SOPHIAN LAWRENCE. *Adenosarcoma of body of uterus*. *Am. J. Obst. & Gynec.* 1932, 24, 911.
13. VON FRANKE O. *Ztschr. f. Geburtsh. u. Gynaek.* 1893, 40, 214.
14. WILMS M. *Die Mischgeschwulste der Vagina und der Cervix Uteri*. Leipzig: A. Georgi, 1900.
15. WOLFE S. A. *Am. J. Obst. & Gynec.* 1930, 19, 816.

EDITORIALS

SURGERY Gynecology and Obstetrics

FRANKLIN H. MARTIN
Founder and Managing Editor
1903-1933

LOYAL DAVIS, EDITOR

Associates

SUMNER L. KOCH MICHAEL L. MASON

DONALD C. BALFOUR, *Associate Editorial Staff*

DECEMBER 1939

TRACTION IN THE TREATMENT OF FRACTURES

THE least understood, the least efficiently employed, and yet the most important factor in the treatment of fractures, is traction. Every discourse upon fracture treatment insists upon traction with manipulation, yet even when full length has been obtained at the time of primary reduction, position of the fragments is often lost in the original splint or cast because of failure to maintain the limb in full length. When manual pull or bandages with pressure are employed, traction must often be released at once because of interference with circulation or because of undue pressure on the soft parts. Even when mole skin, adhesive plaster, or a skeletal pin has been used, these may loosen at once or in a day or two if insufficient pull is being employed to maintain length and complete reduction of the fracture.

With loss of traction following primary reduction, there is a tendency toward deviation or angulation at the point of fracture as

shortening of the limb occurs. Under such circumstances deformity and disability, in some degree, are inevitable. Also in such cases which is practically always, when weight and pulley traction are relied upon, rotation of the distal portions of the fracture and the limb occurs. Especially in the leg and in compound fractures, weight and pulley or elastic traction should never be attempted. This is true even when such devices as the Sinclair skate pins or tongs, or Kirschner wires are employed. And it is especially important to note that any device that is movable outside the limb permits loss of length and position to occur as well as loosening of the wires or tongs, etc. in the bone and irritation at the points of exit and entrance in the skin.

The answer to these difficulties is to be found first, in the correct application of traction on the fracture table at the time of primary reduction. Under such circumstances manipulation of the fracture fragments into correct position becomes a simple matter.

Then with the introduction of pins above and below the point of fracture and the application of a plaster of-Paris cast, length and position, as well as permanent immobilization, are assured. This plan of treatment is especially important in compound fractures in which, as we now know, disturbance for secondary dressings is unnecessary. The method applies also in the secondary reduction of fractures, either simple or compound, in which there was failure to maintain complete reduction at the time of, or following, primary treatment.

It is most important to remember that Kirschner wires, ice tongs and other devices

are less efficient than rigid pins included in casts and are likely to be unsatisfactory in these cases. Any instrument which is or becomes loose at a point outside the limb is likely to loosen in the bone also and to cause irritation or necrosis accordingly. Rigidity and immobilization of all the anatomical parts involved as well as skeletal fixation pins, splints and casts employed in the treatment of fractures are of the utmost importance.

H. WINNETT ORR

LATERAL ABERRANT THYROID TISSUE

THE appearance of lateral aberrant thyroid tissue in its position outside of the thyroid up and down the neck anterior to the sternomastoid muscles and in relation to the internal jugular veins occurs so infrequently that its diagnosis is seldom made and its dangers rarely appreciated except by those who are dealing with thyroid cases in considerable numbers. Since all lateral aberrant thyroids are papilliferous in character they are all potentially malignant. Of 36 patients upon whom we have operated for lateral aberrant thyroid tissue malignant degeneration had already taken place in one third of the cases. It is important, therefore, that there be a realization of the existence of these lateral developments of extrathyroid tissue, their dangers and their management.

The true origin of the thyroid gland is a median one represented in the adult by the foramen cecum at the apex of the circumvallate papillae on the posterior third of the tongue from which point it descends through the base of the tongue to its position on the trachea and connected in the fetus to the point of origin by the thyroglossal tract. This tract runs before, through, or behind the hyoid bone as median fusion of that structure

relates itself to the descent of the thyroid. It is along this median tract that true developmental aberrant remnants of the descending thyroid occur.

Rarely there occurs, however, aberrant thyroid tissue originating laterally from the ultimo branchial bodies and it is with these laterally located thyroid developments that we are here concerned. Lateral aberrant thyroids occur unilaterally or bilaterally. Because they extend upward and downward from the clavicle to the mastoids in front of and beneath the anterior border of the sternomastoid muscles as soft discrete and movable gland-like structures, they are very often mistaken for enlarged cervical lymph nodes. When malignancy occurs in these laterally located nodules of aberrant thyroid tissue, metastases sometimes occur into the thyroid gland itself with the development in that structure of a discrete thyroid nodule. When this nodule in the thyroid is removed and submitted to a pathologist not well versed in thyroid pathology, a report may be returned stating only that it is a cancer of the thyroid. This may result and has in cases sent to us at such a stage in the assumption on the part of the operating surgeon and the attending pathologist that the primary lesion was in the thyroid and that the lateral gland-like structures represent metastases in the adjacent cervical lymph nodes when an exactly reverse situation was the fact. Likewise the return of a report of cancer when one or more of the laterally located cervical lymph node-like structures has been removed and submitted for examination may be confusing to those inexperienced with this lesion.

The typically papilliferous appearance of these lesions either in their primary lateral location or when they have metastasized into the thyroid should always make one suspicious that they are lateral aberrant thyroids.

The occurrence of a chain of discrete movable, non tender, gland like structures up and down the neck in front of the sternomastoid muscles either on one or both sides should make one suspicious of the possibility that they are lateral aberrant thyroid tissue

It is extremely important to diagnose such lateral aberrant thyroids properly. Since in many cases they will not have already become malignant, radical dissections of both sides of the neck from the clavicles to the mastoids should be instituted against the possibility of later malignant degeneration. If malignancy has already taken place not only should both sides of the neck be completely and

radically dissected with the removal of all aberrant thyroid tissue but all nodules within the thyroid itself likewise should be widely removed at the same time. Since these papilliferous tumors, often macroscopically dark in color because of hemorrhage into them, are so radiosensitive whether or not malignant degeneration has occurred, the operation should be followed by intensive high voltage x ray radiation to both sides of the neck. In the absence of malignant degeneration, the outlook following these procedures is excellent and even when malignancy has already occurred but one patient died following this form of treatment.

FRANK H. LAHEY

MEMOIRS

HARVEY CUSHING

1869-1939

IT IS difficult for those who knew him to believe that Harvey Cushing is not still among us. His pervasive personality, which penetrated into so many and such varied circles was something that seemed timeless as well as ageless, an ever living being like a dweller on Olympus who deigned to mingle with mortals. To the present generation of physicians Dr. Cushing was a perpetual inspiration not only as the most brilliant and gifted surgeon of his time, but as teacher and investigator, author, artist, philosopher, and friend.

As if intended to carry out the variation of Shakespeare in all three of its phases

Some are born great
Some achieve greatness
And some are born in Ohio —

Dr. Cushing was born in Cleveland on April 8, 1869, and as he himself says,

I though long away from this community (1924) I still instinctively regard it as home and consider myself a member at least of your medical family. A long heritage of physicians was his from father, grandfather, and great grandfather. Small wonder then that he should write (1923) "The medical traditions of my forebears inclined me to the abnegating life of a general practitioner. To this I looked forward during my medical course and I still think there is no more satisfactory or higher calling in medicine. But before launching him on his medical career let us pause for a moment at Yale University where he graduated with the class of '91. For three years he played varsity baseball and became imbued with the spirit of team play. This spirit he constantly exemplified and in exhorting the medical faculty of his alma mater at the opening of the Sterling Hall of Medicine in 1925 we hear his words. Not alone imagination and industry are needed but in addition what is known as the spirit of team play, unselfish loyalty to one another and to your common purposes and objects."

From the Harvard Medical School Cushing was graduated in 1893 with the degrees of M. A. and M. D. and thereafter served as a surgical house officer at the Massachusetts General Hospital. In looking over the records which he kept of his patients during this service drawings of operations appear as harbingers of the daily operative sketches which so beautifully and accurately enrich practically all of his brain tumor records at the Peter Bent Brigham

Hospital In 1896 Dr Cushing secured an appointment at the Johns Hopkins Hospital on the service of William Stewart Halsted, and although there was an abrupt and extraordinary change in the type of surgery to which he had been accustomed, he learned and quickly appreciated the vital fundamentals which the great Halsted taught—absolute hemostasis painstaking care in the handling of tissues, and the value of closing wound, in many layers with fine silk. No one of Halsted's pupils became as accomplished in these principles as Harvey Cushing, nor did any pass them on to others more devotedly. But great as was Dr Halsted's influence, still greater although along different lines, was that of William Osler. It was Osler's friendship, encouragement, inspiration, and helpful criticism, that doubtless fanned the flame which in its infancy perhaps needed just this type of kindling.

After a long term residency in general surgery at Hopkins Dr Cushing went abroad in 1900-1901, and spent what he has termed "The happiest and most profitable year of my life." This year was passed in two physiological laboratories, that of Professor Kronecker in Berne, and with Sherrington in Liverpool. It is significant that in the former he was engaged upon a problem of intracranial pressure, and in the latter he assisted in mapping out with the electric current the motor cortex in anthropoids. Significant too is his own remark regarding the pursuit of these problems upon which he worked "undistracted by the responsibilities of patients, with no thought awake or asleep, beyond the single problem in hand." Early evidence this, of that power of concentration which was among his greatest faculties.

Returning to Johns Hopkins he once more joined Halsted's staff and started as an assistant in surgery in the medical school. During the next ten years he advanced to the rank of associate professor, and in 1912 was called to Boston as Moseley professor of surgery at Harvard and surgeon in chief to the newly finished Peter Bent Brigham Hospital. In these positions he worked and taught until the retiring age of 63, and then in 1933 he accepted the chair of Sterling professor of neurology at Yale University. In this chair, Emeritus after 1937, and as director of studies in the history of medicine he remained until his death, October 7, 1939, almost exactly six months after his 70th birthday.

These are the bare chronological facts. What was the harvest of the years? First, and foremost as he would have it, let us look at Harvey Cushing the surgeon. Having become thoroughly trained in general surgery, and doubtless fired by his investigative experiences upon the brain in animals, he had conceived the idea of developing neurological surgery as a specialty upon his return to Baltimore in 1901. Furthermore, he had seen as an interne the inadequacy and hopelessness of operations upon the brain as carried out at that time—a small trephine opening by the surgeon at a point on the patient's skull indicated by a neurologist—and of course no lesion found. Of this he says "To every onlooker the only

will edify you to know that it is on the familiar subject of the pituitary body and its disorders—and I promise never to do the like again' Promise indeed! It merely showed that some promises are better broken than kept. The monograph appeared in 1912 and was admittedly the last word upon all that was then known concerning the pituitary. It not only incorporated the fundamental and classical investigations of Dr. Cushing and his associates in the Hunterian Laboratory at Hopkins on the physiology of the hypophysis but contained an imposing array of case reports and operations upon tumors of the gland thus establishing beyond doubt the operability of these tumors and the benefits derived thereby. In the succeeding twenty years his interest in the pituitary continued unabated, frequent important papers and monographs appearing on this subject. Finally in 1932 he described a syndrome associated with basophilic adenomas of the gland and this has become known as Cushing's disease.

But other fields in neurological surgery and its allied problems were tilled vigorously as his three hundred and more published articles and monographs so patently testify. Practically all represent important contributions. His 'Surgery of the Head in Keen's System' in 1908 was the standard of its day. *Tumors of the Verminous and the Syndrome of the Cerebellopontile Angle* was published as a monograph in 1917. This was revolutionary. It placed the surgery of these benign tumors on a reasonably safe surgical basis for the first time and offered a means of giving most of his patients relief of symptoms for prolonged periods. With Dr. Percival Bailey in 1926 he published *A Classification of the Tumors of the Glioma Group on a Histogenetic Basis with a Correlated Study of Prognosis*. This was the first attempt by anyone to bring order out of chaos in this largest class of brain tumors and to gain some knowledge of their natural history. Important studies with other collaborators on distortions of the visual fields in various types of brain tumor, and a series of studies largely with Dr. Lewis H. Weed on the cerebrospinal fluid and its pathways came out from time to time between 1911 and 1921. Almost all the varied forms of brain tumors were dealt with individually but more than all others the meningiomas. Finally, in 1928 in collaboration with Dr. Louise Eisenhardt his last and largest scientific monograph was published. This was, *Meningiomas: Their Classification, Regional Behavior, Life History and Surgical End Results*. One other monograph should be mentioned namely *Intracranial Tumors: Notes upon a Series of Two Thousand Verified Cases with Surgical Mortality Percentages Pertaining Thereto*. This summary of his life's work with brain tumors appeared in 1932 the year in which he retired from surgical work. These results stand today unequalled and unapproached by those of any other.

It is obviously impossible in a short memorial of this kind to do more than mention briefly a few of the highest points in a life which was so full and of such varied activity. Dr. Cushing's twenty years at the Brigham Hospital were

interrupted by two years spent in France with the British and American Expeditionary Forces 1917-1918. With the former at its Casualty Clearing Station in the Ypres sector he developed and subsequently published a method of surgical treatment for gun-shot wounds of the skull and brain. This method at once became a standard and reduced the mortality for such injuries to a considerable degree. In 1918 he was called to the American Forces as Senior Consultant in Neurological Surgery with the rank of colonel. He was honored with the Distinguished Service Medal by the United States, Companion of the Bath by Great Britain and Officer of the Legion of Honor by France. Throughout the war he kept a detailed diary and from this long record he wrote and published in 1926 *From a Surgeon's Journal*, a book equally fascinating to laymen and physicians.

If Harvey Cushing had never been known for anything else, his *Life of Sir William Osler* would of course have made him famous. This magnificent biography in two large volumes, winner of the Pulitzer Prize, was written at Lady Osler's request, and completed in 1925. How he managed to do this and at the same time to carry on his usual hospital duties will forever remain a mystery even to those who watched him at the task.

What were Dr. Cushing's recreations? Writing of course counted although this may be said to have been part of his daily work. Secondly, he was from his earliest years in medicine a bibliophile, but not in any sense a mere collector of books. He had a magnificent medical library but on which "worked his passage" for himself, his pupils, and his associates. He became a profound student of the history of medicine, and to read even a handful of his papers is to become fairly familiar with the story of our profession and with those who have passed the torch. During the summer he enjoyed playing tennis two or three times a week and on Sunday afternoons many of his pupils as well as some of the house staff at the Brigham gathered at his court at 305 Walnut Street, Brookline, to play doubles turn about. Mrs. Cushing always presided at the tea table beside the court and was an inviolable hostess. Indeed, even the full life story of Harvey Cushing's life and work would not be complete without mention of her, a perfect complement to the greatest medical figure of our time.

It is quite obvious that Dr. Cushing should be and was honored in a host of ways. He was a member of innumerable medical and surgical societies in this country and served a term as president of the American College of Surgeons, the American Surgical Association, and the American Neurological Association. He was an honorary member of countless foreign medical and related organizations. He held honorary fellowships in the Royal College of Physicians, Ireland, and Edinburgh and in similar organizations in France, Germany, Italy, Belgium, and other lands abroad. Honorary degrees were granted to upon him from the leading universities in America and Europe. And all this he received in his own simple and modest way. As he himself said of medals: "I never have ever taken for

much adulation with such an equable air almost of ignoring it " The same was true when his friends gathered to do him honor on his 60th birthday at which time the *Archives of Surgery* published a special number as a *Festschrift* containing articles by nearly all of his pupils and associates Again, on his 70th birthday in April just passed, the Harvey Cushing Society, a group of workers in neurological fields, held their annual meeting in New Haven and were his hosts on this occasion The "Chief" was in excellent form and seemed perhaps in as good health as he had been in recent years, better in fact than he had been during his first couple of years in New Haven when he had suffered severe pain in his legs from a combination of arterial diseases Throughout the summer he was actively writing but died suddenly on October seventh from coronary occlusion His burial was in Cleveland, the home of his boyhood from which as he said, "time and distance could never wholly wean us " We think of him, however, in his last years happily ensconced in his old alma mater, working and writing among his books stimulating as ever to the faithful friends, pupils, and associates around him in an atmosphere which was wholly congenial

Harvey Cushing will be remembered as an inspiring leader, a man who aimed at perfection in all things and attained it in great measure by hard work, simplicity of life and a capacity for taking infinite pains To these he added a highly imaginative intellect and unusually keen powers of observation He had to a magnificent degree the crusading spirit and combative vigour necessary to force his views upon a reluctant and traditionally conservative profession " Or, as he puts it in a different way No idea is wholly new, what is new is getting people to adopt it and to act upon it " Thus he was able to "ripen his time "

' By their fruits ye shall know them '

GILBERT HORRAX.

THE SURGEON'S LIBRARY

REVIEWS OF NEW BOOKS

THE elaborate work, *Iodoventriculografia*,¹ in which Carnillo discusses a relatively circumscribed field of neurological diagnosis has been prepared in 4 parts. The first division deals with the general fundamentals of the procedure with emphasis on the lack of precision in the ordinary symptomatology of tumors of the posterior fossa. Fine topographical diagnosis can be of great benefit to the surgeon. Chapter III presents a review of neurosurgical methods of diagnosis, comparing the results and possibilities of each method for the localization of the surgical lesions of the posterior fossa. There is a long discussion on the relative value of air and of lipiodol as contrast media in ventriculography and a comparison of lipiodol with thorotrast. The author's technique of iodoventriculography is discussed in great detail. A number of anatomical and experimental methods are described and a mass of statistics are offered.

The second part deals with iodoventriculographic symptomatology. The various normal and pathological findings of the aqueduct of Sylvius and of the third and fourth ventricles are discussed in considerable detail, in fact, all the possible alterations of the structures of the posterior fossa are adequately handled. Serial roentgenograms are recommended.

The third part deals with iodoventriculographic syndromes for the various tumors and diseases.

The fourth and final section emphasizes the value of iodoventriculography in surgery of the posterior fossa. The author is of the opinion that no surgeon who wishes to proceed conscientiously should operate on the posterior fossa without first practicing iodoventriculography. This method facilitates the differential diagnosis from supratentorial lesions, localizes the level of the tumor within the posterior fossa, and excludes the existence of a disease not associated with tumor formation.

The author's work is based on more than 550 cases undoubtedly the largest series of its kind in the world.

JAMES T. CASE

IN *The Principles and Practice of Ophthalmic Surgery*,² Spaeth has given American ophthalmology a complete text on the surgery of the eye. Ophthalmology is considered as a branch of internal medicine, having a definite surgical aspect.

The work is a thoroughly practical guide to the surgery of the eye. The chapters devoted to the essentials of reconstructive ophthalmological plastic

surgery are especially complete and well illustrated. This is due to the author's extensive experience in this special field and will be found most valuable. The text on keratoplasty has been written by Dr. Ramon Castroviejo, and that on goniotomy by Dr. Otto Barkan.

Diagnosis and surgical treatment are included in each group of operations. A discussion of the pathological conditions and the methods of examination necessary for the proper diagnosis are also given. Not only the author's procedure but certain other generally approved methods are included. The illustrations are profuse and most are excellent. This book is probably the most extensive and exhaustive work on ophthalmic surgery produced in the English language and is earnestly recommended to all practicing ophthalmologists.

SAMUEL J. MEYER

THE many recent advances in the management of gonorrhea are recorded in the third edition of *Gonorrhea in the Male and Female*,³ which is a complete revision of the second edition of this work. The text is divided into 3 parts: one devoted to male infections, one to female infections, and a section on the medical profession and gonorrheal control.

The foundation for study of gonorrhea in the male is laid in a clear anatomical and histological picture. The influence of the histological structure on an initial infection and defense processes and that of anatomical structure on drainage has been carefully considered. Particularly interesting in the section on the gonococcus is the information regarding the thermal death point of the organism, especially in relation to the use of hyperthermia in the treatment of gonorrhea. The difficulties of diagnosis in gonorrhea are reiterated, and methods of culture, fixing, and staining are outlined. One entire chapter is devoted to the consideration of urethral discharges other than those due to gonorrhea.

A conservative attitude toward the results obtainable with sulfanilamide is assumed, this conclusion being drawn from tabulation of the results of many workers. The author divides his sulfanilamide patients into 3 groups: those who are absolutely cured, those who become carriers of the disease, and those who were unaffected by the drug. The dangers in the use of the drug are presented both from the standpoint of toxicity and particularly from the carrier state often produced by sulfanilamide. The necessity of local treatment in conjunction with sulfan

¹IODOVENTRICULOGRAFIA (FOSSA POSTERIOR). By Dr. Ramon Carnillo. Buenos Aires: Frascoli y Bieda, 1937.

²THE PRINCIPLES AND PRACTICE OF OPHTHALMIC SURGERY. By Edmund B. Spaeth, M.D. Philadelphia: Lea & Febiger, 1939.

³GORRHEA IN THE MALE AND FEMALE. A BOOK FOR PRACTITIONERS. By F. S. Pelouze, M.D. 3d rev. ed. Philadelphia and London: W. B. Saunders Co., 1939.

such indices must be, a compromise. The ideal index designed to meet every need of the user would be far too detailed and voluminous to be practical. The period of time covered by the indices (1903-1937) corresponds precisely to the period covering the inception and growth of the roentgen ray, and radium. A reasonable adjustment between the ideal and the practical has been accomplished.

The American Roentgen Ray Society and the publisher are to be congratulated upon presenting to the medical world a complete index of its entire publications. This volume will be a most useful and time saving addition to every medical library as well as to the personal library of all radiologists and physicians interested in the use of the roentgen ray and radium.

EARL E. BARTH

IN the revised and enlarged second edition of *Light Therapy*¹ Krusen presents chapters on the history, physics, and sources of therapeutic light on the need for more accurate selection of therapeutic rays, physiological action, technique of application, forms of administration, and the indications for light therapy. There are then to concise chapters on the indications for ultra violet radiation in various diseases. The final chapters are on the indications for luminous heat and infra red radiation contra indications to light therapy, and the dangers and limitations of this type of therapy. This excellent monograph is well printed and illustrated and can be recommended highly to those interested in light therapy.

JOHN S. COULTER

A DEFINITE need exists for competent summaries of the present status of physical treatment. The author of *The 1938 Year Book of Physical Therapy*² has given a competent summary of the recent literature pertinent to this subject and he is to be congratulated on his excellent work.

The first part presents the material relating to new developments in basic research and the practical applications of the various physical energies. The second part considers the present status of clinical usage of these physical agents in the various departments of medicine and surgery. Electrotherapy, artificial fever therapy, light therapy, hydrotherapy, haloneotherapy and climatotherapy, mechanotherapy, and physical education are considered but x ray and radium, because they have become established as a separate medical specialty, are omitted.

This book fills a definite gap in medical literature as it contains a convenient source of information on the recent progress in the use of physical agents as adjuncts to medicine and surgery.

JOHN S. COULTER

THE author of *Clinical Roentgenology of the Digestive Tract*³ has endeavored to cover every

phase of the gastro intestinal tract in a comprehensive and concise manner and to compile all this material in one book. He has succeeded admirably. Throughout the volume Dr. Feldman discusses not only the roentgenological considerations of disease of the gastro intestinal tract but also the clinical, surgical, and pathological aspects. As an example of this manner of presentation in the chapter devoted to duodenal ulcer, which covers nearly 30 pages, the author discusses historical phases and etiological aspects, anatomy, pathology, roentgen findings both direct and indirect, and technique. This systematic correlation of the clinical and roentgenological findings of the various diseases greatly enhances the value of the book. Heretofore this has been accomplished only in an incomplete manner.

The book contains 1,010 pages, 358 illustrations, and 179 tables. With a few exceptions, the reproductions of roentgenograms are in the negative form. These are clear, well chosen, and instructive. Tables containing statistical data are used generously and to good advantage throughout the book. The author has covered an enormous amount of literature as attested by nearly 6 pages of references at the end of the chapter on gastric ulcer. A similar reference list appears at the end of all 220 chapters. Roentgen technique is discussed whenever pertinent.

The subject matter has been divided into the following sections: esophagus, stomach, duodenum, small intestines, colon, hernia, appendix, gall bladder, pancreas, and miscellaneous. Within each section a chapter is devoted to each affection of that particular organ. The discussion of the stomach, for instance, is divided into 51 chapters. Every phase of the stomach has been covered in a comprehensive and concise manner. The author stresses the importance of the association of the roentgenological study with the clinical aspects of the diseases of the gastro intestinal tract. In this manner he has presented the importance of the diagnostic value of the roentgen study.

The book will be appreciated particularly by roentgenologists and gastro enterologists but is recommended to any student or physician who wishes to learn more about the diagnostic roentgenology of the digestive tract. The book is well written, is characterized by its completeness and is recommended without reservation.

AS in previous years, *The 1938 Year Book of Radiology*⁴ presents the same excellent, concise yet adequate review of the literature dealing with radiology. The articles selected for review from the literature have been wisely chosen. The editorial comments appearing at the end of selected reviews enhance the value of the book. A very interesting biographical article on the life of Roentgen by Dr. Glasser is reprinted almost in its entirety.

The publisher is to be congratulated on the excellence of the reproductions. The appearance of

¹ LIGHT THERAPY. By Frank Hammond Krusen, M.D., 2d rev. and ed. New York: Paul B. Hoeber, Inc., 1937.

² THE 1938 YEAR BOOK OF PHYSICAL THERAPY. Edited by Richard Kovacs, M.D. Chicago: The Year Book Publishers, 1938.

³ CLINICAL ROENTGENOLOGY OF THE DIGESTIVE TRACT. By Maurice Feldman, M.D. Baltimore: William Wood & Co., 1938.

⁴ THE 1938 YEAR BOOK OF RADIOLOGY. DIAGNOSIS. Edited by Charles A. Waters, M.D., and Whitmer B. Frior, M.D. Therapeutics. Edited by Ira I. Kaplan, B.Sc., M.D. Chicago: The Year Book Publishers, Inc., 1938.

illustrations a page or more from the article is somewhat annoying but is no great distraction. Radiological diagnosis is divided into the following sections: osseous system, skull sinuses and mastoids, soft tissues, glandular system, respiratory system, cardiovascular system, gastro-intestinal system, genito-urinary system, obstetrics and gynecology, nervous system, technique and teaching and principles of practice. Radiotherapeutics is handled in a similar manner. Sections are devoted to biology, physics, radiation in the various special fields such as neurology, ophthalmology, dermatology, otolaryngology, chest, breast, gastro-intestinal tract, gynecology, genito-urinary system, bone conditions and radiation injuries.

Although there have been no startling new discoveries, the reviews indicate a continued expansion in the field of usefulness of the roentgen ray. The rotary kymograph, thoracic 'serioscopy' and the improved laminagraph are worthy of note. One is

impressed with the vast amount of research which is being done throughout the world on cancer in an effort to ascertain the etiological factors. From the reports made on observations with supervoltage x-ray therapy, one gathers the impression that the results while hopeful do not warrant the replacement of the usual 200 kilovolt unit procedure. The author has expressed the situation very aptly as follows: 'Experience has shown that clinical kill is not mere increased voltages, makes for more cures. Radiation is rapidly gaining more and more favor in the treatment of infections as well as other benign lesions.'

As the reviewer has stated in previous years, *The Year Book of Radiology* should be one of the most valuable books in the radiologist's library. The volume will be of interest to any physician who is desirous of acquainting himself with the recent advances which have been made in radiology.

CARL E. BAETH

BOOKS RECEIVED

Books received are acknowledged in this department and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as page permits.

A TOPOGRAPHIC ATLAS FOR X-RAY THERAPY. By Ira J. Kaplan, B.S. M.D. and Sidney Rubenstein, B.S. M.D. Chicago, Ill. The Year Book Publishers, Inc. 1939.

GYNECOLOGY, MEDICAL AND SURGICAL. By I. Brooke Bland, M.D. F.A.C.S. Assisted by Arthur First, M.D. 3d rev. ed. Philadelphia, F.A. Davis Co. 1939.

A TEXT BOOK OF OCCUPATIONAL DISEASES OF THE SKIN. By Louis Schwartz, M.D. and Louis Tulipan, M.D. Philadelphia, Lea & Febiger, 1939.

SYNOPSIS OF PEDIATRICS. By John Zahorsky, A.B. M.S. F.A.C.P. Assisted by T.S. Zahorsky, B.S. M.D. 3d ed. St. Louis, The C.V. Mosby Co. 1939.

INFECTIONS OF THE HAND. By Lionel R. Fifield, F.R.C.S. (Eng.) 2d ed. By Patrick Clarkson, F.R.C.S. (Eng.) New York, Paul B. Hoeber, Inc. 1939.

A SYNOPSIS OF SURGICAL ANATOMY. By Alexander Lee McKeagor, M.Ch. (Ireland), F.R.C.S. (Eng.) 4th ed. Baltimore, The Williams & Wilkins Co. 1939.

HISTORICAL MIDWIFERY, AN ATLAS OF MIDWIFERY FOR PUPIL MIDWIVES. By Sir Comyns Berkeley, M.A. M.C. M.D. (Cantab.) F.R.C.I. (Lond.) F.P.C.S. (Eng.) Hon. M.S.A. F.C.O.G. 3d ed. A William Wood Book. Baltimore, The Williams & Wilkins Co. 1939.

CAESAREAN SECTION, LOWER SEGMENT OPERATION. By C. McIntosh Marshall, F.R.C.S. (Eng.) A William Wood Book. Baltimore, The Williams & Wilkins Co. 1939.

TREATMENT OF SOME COMMON DISEASES (MEDICAL AND SURGICAL). By Various Authors. Edited by T. Rowland Hill, M.D. (Lond.) M.R.C.P. (Lond.) A William Wood Book. Baltimore, The Williams & Wilkins Co. 1939.

TEXTBOOK OF NERVOUS DISEASES. By Robert Bing. Translated and enlarged by Webb Haymaker. From the 5th German ed. St. Louis, The C.V. Mosby Co. 1939.

STEDMAN'S PRACTICAL MEDICAL DICTIONARY OF WORDS USED IN MEDICINE WITH THEIR DERIVATION AND PRO-

NOVIATION. By Thomas Jathrop Stedman, A.M. M.D. and Stanley Thomas Garber, B.S. M.D. 14th rev. ed. Baltimore, The Williams & Wilkins Co. 1939.

OBSTETRICAL PRACTICE. By Alfred C. Beck, M.D. 2d ed. Baltimore, The Williams & Wilkins Co. 1939.

CIRCULATORY DISEASES OF THE EXTREMITIES. By John Homans, M.D. New York, The Macmillan Co. 1939.

THE 1939 YEAR BOOK OF RADIOLOGY, DIAGNOSIS. Edited by Charles A. Waters, M.D. and Whitmer B. Frior, M.D. THERAPEUTICS. Edited by Ira J. Kaplan, B.S. M.D. Chicago, The Year Book Publishers, Inc. 1939.

BLOOD GROUPS AND BLOOD TRANSFUSION. By Alexander S. Wiener, A.B. M.D. 2d ed. Springfield, Ill. and Baltimore, Md. Charles C. Thomas, 1939.

IL CANCRO DELLO STOMACO. By Luigi di Natale. Bologna, Italy, Luciano Cappelli, 1939.

PRIMER CONGRESO CHILENO Y AMERICANO DE CIRUGIA. Sociedad de Cirujanos de Hospital S. Matías, Chile. Imprenta Universitaria, 1939.

CIRUGIA MEDICA, OPHTHALMOLOGY. By Burton Chance, M.D. New York, Paul B. Hoeber, Inc. 1939.

FRACTURES. By Paul B. Magnuson, M.D. F.A.C.S. 3d rev. ed. Philadelphia, J.B. Lippincott Co. 1939.

TUMORS OF THE SKIN, BENIGN AND MALIGNANT. By Joseph Jordan Eller, M.D. Philadelphia, Lea & Febiger, 1939.

THE MERCK INDEX. 5th ed. Rahway, N.J. Merck & Co., Inc. 1939.

CIRUGIA MEDICA. A Series of Primers on the History of Medicine. Edited by F.B. Krumhaar, M.D. Vol. XI—BACTERIOLOGY. By William W. Ford, M.D. D.P.H. New York and London, Paul B. Hoeber, Inc. 1939.

PATOLOGIA Y CIRUGIA DEL ESFINTER DE ODDI. By Delfor del Valle. Buenos Aires, Argentina, Librería y Editorial Li Atento, 1939.

FOLICULOCOSIS PULMONUM. ESTUDIO ANATOMOPATOLOGICO-RADIOENDOCRINOGRAFICO Y TERAPEUTICO. By Raúl A. Paggio Blanco and Federico García Capurro. Buenos Aires, Argentina, Librería y Editorial El Atento, 1939.

SUBJECT INDEX TO VOLUME 69

ABDOMEN Problems in differential diagnosis between urologic and abdominal lesions 671

Aberrant thyroid tissue Papillary tumors of thyroid and lateral origin 39 1 lateral ed 826

Abnormalities Anomalies of renal rotation 183 Wadlung's deformity and associated deformity at elbow, 225, congenital Clinical aspects of sacrococcygeal teratomas 337

Acetabulum Treatment of fractures of the pelvis 508

Acetylcholine as diagnostic test in cases of congenital megacolon 762

Adenocarcinoma Malignant mixed tumors— of the corpus uteri 818

American College of Surgeons—
Clinical Congress Plans for 1939 in Philadelphia 126
Preliminary program for 1939 385 Complete program for 1939 in Philadelphia 543

American Congress on Obstetrics and Gynecology cor 124

American Urological Association Registry Surgical treatment of infiltrating carcinoma of bladder 113

Amniotic fluid Aspiration of by fetus experimental roentgenological study in guinea pig 705

Amputation Interscapulothoracic for malignant tumors of shoulder region 234

Anesthesia Oxygen therapy in reactions following barbiturate and cisternal intervention 305 Effect of obstetrical upon oxygenation of maternal and fetal blood with particular reference to cyclopropane 584

Arm Study of pathologically verified epidermoid carcinoma of skin 726 Swollen Method for prevention of elephantiasis chirurgica 795

Artery internal mammary axillary Blood supply of mammary gland 468 pulmonary Maintenance of life during experimental occlusion followed by survival 602

Atrophy Sudeck's Atrophy of bone ed 251

Axilla Method for prevention of elephantiasis chirurgica 795

BACK Intraspinal causes of low and sciatic pain results in 60 consecutive low lumbar laminectomies 446

Barbiturates Oxygen therapy in reactions following anesthesia and cisternal intervention 305

Bence Jones proteinuria Multiple myeloma 648

Biliary tract Acute cholecystitis 431

Bladder Simple method for keeping dry fistulas from cervix cancer 111 Surgical treatment of infiltrating carcinoma of 113 Operative technique for treatment of vesicovaginal and ureterovaginal fistulas 663, Problems in differential diagnosis between urologic and abdominal lesions 671 Total cystectomy for carcinoma of ed 699

Blood Effect of obstetrical anesthesia upon oxygenation of maternal and fetal with particular reference to cyclopropane 584

Blood analysis Multiple myeloma, 648

Blood transfusion New and safer method of citrated cor 125

Blood vessels Instrument to measure arterial pulsation in digits 103 peripheral lumbectomy for peripheral embolism ed 117 Conservative treatment of diabetic gangrene 342 Blood supply of mammary gland surgical considerations 468 Etiological factors in varicose veins of lower extremities 717

Bodies Bence Jones Multiple myeloma 648

Bone Madelung's deformity and associated deformity at elbow 225 tumors of Interscapulothoracic amputation for malignant tumors of shoulder region 234

Atrophy of ed 251, tumors of Management of pathological fractures 524 long Congenital bowing and pseudarthrosis of lower leg manifestations of von Recklinghausen's neurofibromatosis 618 Multiple myeloma 649

Bowlegs Congenital bowing and pseudarthrosis of lower leg manifestations of von Recklinghausen's neurofibromatosis 618

Bron Oxygen therapy in reactions following barbiturate anesthesia and cisternal intervention 305

Breast Carcinoma of end results Massachusetts General Hospital 1930 1931 and 1932 171 Method for prevention of elephantiasis chirurgica 795 Improved incision for radical operation for carcinoma of 816

CANCLER control in rural sections ed 380

Carcinoma Gastroscopy in gastric especially in its early diagnosis 1 Question—ulcer or, ed 115 of breast end results Massachusetts General Hospital 1930 1931 and 1932 171 of cervix treated by roentgen ray and radium 257 Treatment of of uterine cervix 373 of cervix ed 379 Significance of radiation reaction in of cervix uteri 645

Celone Significance of cerivamic acid deficiency in surgical patients 745

Cervical cysts Cystic hygroma of neck 48

Cervitamic acid Significance of deficiency in surgical patients 745

Cheek Study of pathologically verified epidermoid carcinoma of skin 726

Childbirth Effect of obstetrical anesthesia upon oxygenation of maternal and fetal blood with particular reference to cyclopropane 584 Sulfanilamide therapy in severe puerperal infection 631

Chin Study of pathologically verified epidermoid carcinoma of skin 726

Cholecystitis Acute 431

Cholecholethotomy MacCormick's technique 95

Chondrosarcoma Interscapulothoracic amputation for malignant tumors of shoulder region 234

Chromatin distribution of Cyclic changes in of nuclei of endometrium 18

Clavicle Fractures of, ambulatory treatment by suspension elevation 770

Cloaca Experimental study of uretero intestinal implantation 11 Significance of normal ureterocloacal arrangement in some reptiles and all aves 713

Colitis chronic ulcerative Intestinal polyps pathogenesis and relation to malignancy, 136

Collapse therapy Extrapleural pneumothorax 804

Colocolostomy Palliative for inoperable malignant lesions of colon 110

Colon Palliative colocolostomy for inoperable malignant lesions of 110 Acute diverticulitis of 474

Congenital indirect inguinal hernia Technical notes on 207

Cranotomy Technique of osteoplastic 659

Cushing Harvey op 577 ed 697 828

Cyclopropane Effect of obstetrical anesthesia upon oxygenation of maternal and fetal blood with particular reference to 584

Cystectomy, Total for carcinoma of bladder, ed 699

- DEHYDRATION** McClure Aldrich test in water balance following operation 637
- Denovillier's space** For urethral resection of the prostate 493
- Diabetes** Conservative treatment of diabetic gangrene 342 33 pregnancies in diabetic women 695
- Diagnosis** Gastroscopy in gastric carcinoma especially in its early diagnosis 4 differential Question—ulcer or carcinoma ed 115 differential Problems in between urologic and abdominal lesions 697
- Dilatation of blood and urine** Diagnosis of pancreatic disease ed 530
- Dislocation** von Heeklinghausen's neurofibromatosis Congenital bowing and pseudarthrosis of lower leg manifestations of 618
- Dysinfection** skin Mercuric chloride potassium mercuric iodide and Harrington's solution in behavior and uses 594
- Dysenteritis** Acute of colon 474
- Duodenum** Technique of subtotal gastrectomy for ulcer 494 Acute perforated peptic ulcer simple closure through short transverse incision 669 Technique of gastric resection for gastroduodenal ulcer 765
- EAR** Study of pathologically verified epidermoid carcinoma of skin 27
- Fetal** status maternal and fetal blood Effect of technical anesthesia upon oxygenation of maternal and fetal blood with particular reference to cyclopropane 54
- Excision** of lumps Cancer control in rural sections ed 380
- Forearm** Madelung's deformity and associated deformity at 221 Non traumatic paralysis of dorsal interos. nerve 354
- Elephantiasis chirurgica** Method for prevention of 795
- Embolism** for peripheral embolism ed 57
- Empyema** Treatment of thoracic empyema 209 chronic Treatment of by continuous high vacuum suction 240
- Endometria** of lungs experimental production of endometrial transplants in lungs of rabbits 577
- Endometrium** Cyclic changes in chromatin of nuclei of 18 Endometriosis of lungs experimental production of endometrial transplants in lungs of rabbits 577
- Enophthalmos** Traumatic 400
- Epidermoid carcinoma** Study of pathologically verified of skin 716
- Esoophagus** Pul on diverticula of hypopharynx review of 41 cases in which operation was performed and report of 2 cases 364
- Estrin** Results of attempted induction of labor with 155
- Exophthalmic goiter** Surgical treatment of 333
- Eyes** Traumatic enophthalmos 400
- Eyelid** Study of pathologically verified epidermoid carcinoma of skin 720
- FALLOPIAN tubes** Conservative myomectomy 214 Famous autographs Joseph Lister letter 254 Famous portraits Sir Henry Hallford Bart op 129
- Fascia** use of for sutures Operation for repair of direct inguinal hernia 98 Direct inguinal hernia and method of fascial repair 247 Autoplastic sutures in repair of inguinal hernia 515 Role of in myosynovitis and adhesions 627
- Femur** neck of Intracapsular femoral neck non union 00 Treatment of fractures of pelvis 508 Ununited fractures of neck of ed 697
- Fetus** Aspiration of amniotic fluid by experimental roentgenological study in guinea pig 705
- Fibrosarcoma** Pathological features of soft tissue with special reference to grading of its malignancy 367

- Fingers** Instrument to measure arterial pulsation in digit, 103 Non traumatic paralysis of dorsal interos. nerve 358 Study of pathologically verified epidermoid carcinoma of skin 726
- Fistula** bladder Simple method for keeping dry from cervix cancer 117 Operative technique for treatment of vesicovaginal and ureterovaginal 663
- Foot** New operation for metatarsalgia and splay foot 106 Conservative treatment of diabetic gangrene 342 Study of pathologically verified epidermoid carcinoma of skin 7 6
- Forearm** Madelung's deformity and associated deformity at elbow 221
- Forehead** Study of pathologically verified epidermoid carcinoma of skin 726
- Fractures** Open reduction of with special bone approximator 231 Management of pathological 524 Ununited of neck of femur ed 697 Traction in treatment of ed 825
- GALL BLADDER** Cholecholethotomy MacCormick's technique 93 Experimental production and specific treatment of disease 19 Acute cholecystitis 437 Problems in differential diagnosis between urologic and abdominal lesions 691
- Gangrene** diabetic Conservative treatment of 342
- Gastrojejunostomy** Technique of using crushing clamp 657
- Gastroscopy** in gastric carcinoma especially in its early diagnosis 1

- HAND** Non traumatic paralysis of dorsal interos. nerve 358 Study of pathologically verified epidermoid carcinoma of skin 726
- Harrington's solution** Mercuric chloride potassium mercuric iodide and in skin disinfection behavior and uses 594
- Hernia** surgery of Maintenance of life during experimental occlusion of pulmonary artery followed by survival 602
- Hemorrhage** gastric Surgical treatment of acute pyloric 291
- Hernia** inguinal Operation for repair of direct 98 congenital indirect Technical notes on 207 Direct inguinal and method of fascial repair 247 Clinical study of alloy steel wire sutures in repair 634 Inguinal application of cardinal principles in repair of 685
- Hip** Treatment of fractures of pelvis 508
- Hip joint fracture** Intracapsular femoral neck non union 00
- Hormones** Cyclic changes in chromatin of nuclei of endometrium 18
- Humerus** Interescapulothoracic amputation for malignant tumors of shoulder region 234
- Hygroma** Cystic of neck report of 27 cases 48
- Hypopharynx** Pul on diverticuli of review of 41 cases in which operation was performed and report of 2 cases 364
- ILLUM** Management of hematogenous pelvic osteomyelitis 312
- Incision** short transverse abdominal Acute perforated peptic ulcer simple closure through 669 Improved for radical operation for carcinoma of breast 816
- Infection** Experimental production and specific treatment of gall bladder disease 129 puerperal Sulfanilamide therapy in severe 631
- Inguinal hernia** Operation for repair of direct 98 Technical notes on congenital indirect 207 Direct and method of fascial repair 247 Autoplastic fascia 51

tures in repair of 515 application of cardinal principles in repair of 688

Instruments and apparatus Macdonald liver reserve test 70 Practical and clinical test for liver reserve 70 Gardner oscilometer Instrument to measure arterial pulsation in digits 103 Krida fascial introducer New operation for metatarsalgia and splay foot 106 Hendrickson catheter Stedman electric suprapubic pump Simple method for keeping dry bladder fistulas from cervix cancer 111 Treatment of thoracic empyema 209 bone approximator Open reduction of fractures with special bone approximator 231 Neville chronic empyema Treatment of chronic empyema by continuous high vacuum suction 240 McCarthy resectome Mark's hospital irrigating system for indwelling catheters Per urethral resection of prostate 493 Gibson extracorporeal circuit Maintenance of life during experimental occlusion of pulmonary artery followed by survival 602 Orr crushing clamp Technique of gastrotomy using 657 Rogers skull plough Technique of osteoplastic craniotomy 659 lead glass threaded sponge Safe surgical sponge 694 Studies on chemical sterilization of surgical I Bacteriological evaluation 738 Anderson suspension hammock splint Fractures of clavicle ambulatory treatment by suspension elevation 710 Padgett dermatome, Calibrated intermediate skin grafts 779 Kirschner wire Traction in treatment of fractures ed 825

Intestines atony of Use of prostigmin methylsulfate in prevention of postoperative intestinal atony and urinary bladder retention 61 Palliative colocolostomy for inoperable malignant lesions of colon 110 Intestinal polyps pathogenesis and relation to malignancy 136 small Malignant tumors of study of their incidence and diagnostic characteristics 299 Mikulicz operation development and technique 327 Acute diverticulitis of colon 474 Technique of subtotal gastrectomy for ulcer 498 Technique of gastrotomy using crushing clamp 657 Experimental study of uretero-intestinal implantation II Significance of normal ureterocolic arrangement in some reptiles and all aves 713 Acetylcholine as diagnostic test in cases of congenital megacolon 762

JAUNDICE Choledocholithotomy MacCormick's technique 95

Jejunum Problem of intractable peptic ulcer 287 Technique of subtotal gastrectomy for ulcer 498 Technique of gastrotomy using crushing clamp 657

KIDNEY Pyelonephritic contracture of 139 Anomalies of renal rotation 183 Multiple myeloma 648 Problems in differential diagnosis between urologic and abdominal lesions 671

Knee joint New operative procedure for repair of ruptured cruciate ligaments of 108

LABOR Results of attempted induction of with estrin 155

Leg Congenital bowing and pseudarthrosis of lower manifestations of von Recklinghausen's neurofibromatosis 618 Etiological factors in varicose veins of lower extremities 717

Leg and thigh Study of pathologically verified epidermoid carcinoma of skin 726

Ligament cruciate New operative procedure for repair of ruptured of knee joint 108

Lips Repair of large defects after removal of cancer of 347 Evaluation of neck dissection in carcinoma of 484

Liver reserve Practical and clinical test for 70

Lungs Treatment of thoracic empyema 209 Treatment of chronic empyema by continuous high vacuum suction 240 Role of surgery in recovery of tuberculous individual ed 252 Endometriosis of experimental production of endometrial transplants in lungs of rabbits 577 Extrapleural pneumothorax 804

Lymph nodes Evaluation of neck dissection in carcinoma of lip 484

MADLUNG S deformity and associated deformity at elbow 221

Malar region Study of pathologically verified epidermoid carcinoma of skin 726

Malignancy Intestinal polyps pathogenesis and relation to 136 index of malignancy Pathological features of soft tissue fibrosarcoma with special reference to grading of its malignancy 267 Intestinal Malignant tumors of small intestine study of their incidence and diagnostic characteristics 299 Carcinoma of cervix ed 359 Malignant lesions of thyroid gland review of 774 cases 417

Mammary gland Blood supply of surgical considerations 468

Mastoid region Study of pathologically verified epidermoid carcinoma of skin 726

Mayo Charles H 118

Mayo William J ed 379 op 417 as I Knew Him, 534

Megacolon Acetylcholine as diagnostic test in cases of congenital 762

Memoirs Charles H Mayo 118 Dr William J Mayo as I Knew Him 534 Harvey Cushing 818

Menstruation Cyclic changes in chromatin of nuclei of endometrium 18 vicarious Endometriosis of lungs experimental production of endometrial transplants in lungs of rabbits 577

Mercuric chloride potassium mercuric iodide and Harrington's solution in skin disinfection behavior and uses 504

Method Alexander MacCormick choledocholithotomy 95 Couillard in bladder carcinoma Surgical treatment of infiltrating carcinoma of bladder 113 Linn Key embolectomy Embolectomy for peripheral embolism, ed 117 Lewisohn blood transfusion New and safer method of extrated blood transfusion cor 125 repair of hip joint fracture Intracapsular femoral neck non union 200 Mikulicz operation development and technique 327 Fothergill Treatment of uterine prolapse 800

Metatarsus New operation for metatarsalgia and splay foot 106

Mikulicz operation development and technique 327

Muscle adductor Intrapelvic extraperitoneal resection of obturator nerve 101 Role of fascia in myosynovitis and adhesions 627

Myeloma Multiple 648

Myomectomy Conservative 214

Myosynovitis Role of fascia in and adhesions 627

NECK Cystichyroma of report of 27 cases 48 Evaluation of dissection in carcinoma of lip 484 Study of pathologically verified epidermoid carcinoma of skin 726

Nerve obturator Intrapelvic extraperitoneal resection of 101 dorsal interosseous Non traumatic paralysis of 358 sciatic Intraspiral causes of low back and sciatic pain results in 60 consecutive low lumbar laminectomies 446

- Neurofibroma molluscum** Congenital bowing and pseudarthrosis of lower leg manifestations of von Recklinghausen's neurofibromatosis 618
- Neurofibromatosis** Congenital bowing and pseudarthrosis of lower leg manifestations of von Recklinghausen's 618
- Nose** Study of pathologically verified epidermoid carcinoma of skin 726
- Nucleus pulposus** herniated Intraspinal causes of low back and sciatic pain results in 60 consecutive low lumbar laminectomies 446
- OBSTETRICS** Results of attempted induction of labor with estrin 555 Cold pressor test in pregnancy 436 Complete lacerations of perineum analysis of 205 surgical repairs 518 Effect of obstetrical anesthesia upon oxygenation of maternal and fetal blood with particular reference to cyclopropane 584 Sulfanilamide therapy in severe puerperal infection 631 Aspiration of amniotic fluid by fetus experimental roentgenological study in guinea pig 95
- Ocular** Traumatic enophthalmos 466
- Oomyelitis** Management of hematogenous pelvic 312
- Ovary** Cyclic changes in chromatin of nuclei of endometrium 28 Problems in differential diagnosis between uterine and abdominal lesions 671
- Oxygen content** Effect of obstetrical anesthesia upon oxygenation of maternal and fetal blood with particular reference to cyclopropane 584
- Ovine** thorax in reactions following bisulphate anesthesia and external intervention 395
- PAIN** Intraspinal causes of low back and sciatic results in 60 consecutive low lumbar laminectomies 446 Muscular Rhabdomyolysis in myosynovitis and adhesions 1
- Pancreas** Diagnosis of pancreatic disease 530 Serum amylase in diagnosis of pancreatic disease 531 Fibrosis in differential diagnosis between urologic and abdominal lesions 671
- Palsy** N. traumatic of the dorsal interosseous nerve 358
- Pathological fracture** Management of 424
- Pelvis** Management of hematogenous pelvic osteomyelitis 31 Treatment of fractures of 50th floor of Complete lacerations of perineum analysis of 205 surgical repairs 518
- Perineum** Complete lacerations of analysis of 205 surgical repairs 518 Treatment of uterine prolapse 809
- Peripheral vascular disease** Instrument to measure arterial pulsation in limbs 104
- Pharynx** Fetal liveacula of hypopharynx review of 41 cases in which parathyroid was performed and report of 2 cases 314
- Plastic surgery** Repair of large defects after removal of cancer of hips 347
- Pneumothorax** Extrapleural 404
- Polyps** Intestinal polyps pathogenesis and relation to malignancy 146
- Potassium mercuric iodide** Mercuric chloride and Harrington's solution in skin disinfection behavior and uses 594
- Pregnancy** Ectopic review of 310 operative cases 65 Cold pressor test in 436 33 in diabetic women 613 Aspiration of amniotic fluid by fetus experimental roentgenological study in guinea pig 95
- Proctography** roentgenologic studies of rectum and sigmoid 83
- Prostate** Per urethral resection of 493

- Prostigmin methylsulfate** Use of in prevention of postoperative intestinal atony and urinary bladder retention 61
- Pulsion diverticulum** of hypopharynx review of 41 cases in which operation was performed and report of 2 cases 364

- RADIATION** reaction Significance of in carcinoma of cervix uteri 645
- Radium** Carcinoma of cervix treated by roentgen ray and 257 Treatment of carcinoma of uterine cervix 373
- Radium therapy** Significance of radiation reaction in carcinoma of cervix uteri 645
- Radius** Madelon's deformity and associated deformity at elbow 221
- Rectum** Proctography roentgenologic studies of and sigmoid 83
- Respiration** fetal Aspiration of amniotic fluid by fetus experimental roentgenological study in guinea pig 95
- Roentgen ray** Carcinoma of cervix treated by and radium 257
- Roentgen therapy** Significance of radiation reaction in carcinoma of cervix uteri 645

- SACROCOCCYGEAL** teratomas Clinical aspects of 337
- Sacrocoxa** Management of hematogenous pelvic osteomyelitis 312
- Scalp** Study of pathologically verified epidermoid carcinoma of skin 726
- Scrotum** Study of pathologically verified epidermoid carcinoma of skin 726
- Scurvy** Significance of ascorbic acid deficiency in surgical patients 45
- Serum amylase** in diagnosis of pancreatic disease 531
- Shoulder** Interscapulothoracic amputation for malignant tumors of shoulder region 234 Fractures of clavicle ambulatory treatment by suspension-elevation 70
- Sigmoid** Proctography roentgenologic studies of rectum and sigmoid 83
- Silk** Use of in thyroid surgery 441
- Skin** Mercuric chloride potassium mercuric iodide and Harrington's solution in skin disinfection behavior and uses 594 pigmented Congenital bowing and pseudarthrosis of lower leg manifestations of von Recklinghausen's neurofibromatosis 618 Study of pathologically verified epidermoid carcinoma of 726
- Skin grafts** Sweating function of transplanted skin 756
- Cabrated intermediate** 779
- Skull** Technique of osteoplastic craniotomy 659
- Solution** Harrington's Mercuric chloride potassium mercuric iodide and in skin disinfection behavior and uses 594
- Spine** Intraspinal causes of low back and sciatic pain results in 60 consecutive low lumbar laminectomies 446 Problems in differential diagnosis between urologic and abdominal lesions 671
- Splay foot** New operation for metatarsalgia and 106
- Spleen** Problems in differential diagnosis between urologic and abdominal lesions 671
- Splint** Fractures of clavicle ambulatory treatment by suspension-elevation 70
- Sponge** surgical Safe 694
- Sterilization** Studies on chemical of surgical instruments 1 Bacteriological evaluation 738
- Stomach** Gastroscopy in gastric carcinoma especially in its early diagnosis 1 Question ulcer or carcinoma 215 Surgical gastritis study on genesis of gastritis found in resected with particular reference to so called antral gastritis associated with ulcer 281

- Problem of intractable peptic ulcer 287 Surgical treatment of acute profuse gastric hemorrhages 291 Technique of subtotal gastrectomy for ulcer 498 Technique of gastrojejunostomy using crushing clamp 657 Technique of gastric resection for gastroduodenal ulcer 705
- Stomal Acute perforated peptic ulcer simple closure through short transverse incision 669
- Suction Treatment of chronic empyema by continuous high vacuum suction 240
- Sudek's atrophy Atrophy of bone ed 251
- Sulfanilamide therapy in severe puerperal infection 631
- Surgery Role of in recovery of tuberculous individual ed 25 technique Autoplastic fascia sutures in repair of inguinal hernia 515 technique Safe surgical sponge 694 technique Studies on chemical sterilization of surgical instruments I Bacteriological evaluation 738
- Surgical gastritis study on genesis of gastritis found in resected stomachs with particular reference to so called antral gastritis associated with ulcer 281
- Sutures Direct inguinal hernia and method of fascial repair 247 Use of silk in thyroid surgery 441 Auto plastic fascia in repair of inguinal hernia 515 alloy steel wire Clinical study of in hernia repair 684
- Sweating function of transplanted skin 756
- Synovia Role of fascia in myosynovitis and adhesions 627

- T**EMPLE Study of pathologically verified epidermoid carcinoma of skin 726
- Teratoma Clinical aspects of sacrococcygeal 337
- Test Aschheim Zondek Ectopic pregnancy review of 310 operative cases 65 bromsulphalein dye Practical and clinical test for liver reserve 70 Cold pressor in pregnancy 436 Wohlgemuth for diastase of blood and urine Diagnosis of pancreatic disease ed 530 Wohl gemuth for measuring amylase Serum amylase in diagnosis of pancreatic disease ed 531 McClure Aldrich intradermal salt solution in water balance following operation 637 Trendelenburg Etiological factors in varicose veins of lower extremities 717 Acetylcholine as diagnostic test in cases of congenital megacolon 763
- Tetanus at John Sealy Hospital observations upon distribution of tetanus throughout United States 146
- Thorax Treatment of thoracic empyema 209 Treatment of chronic empyema by continuous high vacuum suction 240
- Thyroid Papillary tumors of and lateral aberrant origin 39 One stage thyroidectomy for thyrotoxicosis in aged 178 Use of silk in surgery 441
- Thyroid gland Surgical treatment of exophthalmic goiter 333 Malignant lesions of review of 774 cases 417
- Thyroid tissue Lateral aberrant ed 826
- Thyroidectomy One stage for thyrotoxicosis in aged 178
- Thyrotoxicosis One stage thyroidectomy for in aged 178
- Thrombo angitis obliterans Conservative treatment of diabetic gangrene 342
- Toes Instrument to measure arterial pulsation in digits 103
- Traction in treatment of fractures ed 525

- Transplantation, Sweating function of transplanted skin 756
- Trunk Study of pathologically verified epidermoid carcinoma of skin 726
- Tuberculosis Role of surgery in recovery of tuberculous individual 25 Extrapleural pneumothorax 804
- Tumors Malignant mixed adenocarcinoma of corpus uteri 818

- U**LCEr gastric Question or carcinoma ed 115 peptic Problem of intractable 287 Technique of subtotal gastrectomy for 498 Acute perforated peptic simple closure through short transverse incision 669 gastro duodenal Technique of gastric resection for 705
- Ureter Operative technique for treatment of vesicovaginal and ureterovaginal fistulas 663 Problems in differential diagnosis between urologic and abdominal lesions 671 Experimental study of uretero intestinal implantation II Significance of normal ureterocolical arrangement in some reptiles and all aves 713
- Uretero intestinal anastomosis Experimental study of uretero intestinal implantation II Significance of normal ureterocolical arrangement in some reptiles and all aves 713
- Ureterovaginal fistula Operative technique for treatment of vesicovaginal and 663
- Urne retention of Use of prostigmin methylsulfate in prevention of postoperative intestinal atony and urinary bladder retention 61
- Urology I problems in differential diagnosis between urologic and abdominal lesions 671
- Uterus cervix Simple method for keeping dry bladder fistulas from cervix cancer 111 Conservative myomectomy 214 cervix Carcinoma of cervix treated by roentgen ray and radium 257 cervix Treatment of carcinoma of 373 Carcinoma of cervix ed 379 cervix Significance of radiation reaction in carcinoma of 645 Treatment of uterine prolapse 809 cervix Malignant mixed tumors adenocarcinoma of corpus uteri 818

- V**AGINA Operative technique for treatment of vesicovaginal and ureterovaginal fistulas 663
- Vein saphenous varicose Etiological factors in varicose veins of lower extremities 717
- Vertebra Multiple myeloma 648
- Vesicovaginal fistula Operative technique for treatment of and ureterovaginal fistulas 663
- Vitamin C Significance of cevitamic acid deficiency in surgical patients 745

- W**ATER balance McClure Aldrich test in following operation 637
- Wound healing Use of silk in thyroid surgery 441 Significance of cevitamic acid deficiency in surgical patients 745
- Wrist Madelung's deformity and associated deformity at elbow 221

- Y**OUNG Professor Archibald cor 702

BOOK REVIEWS

- Consolidated Indices. *Embracing Transactions of the American Roentgen Ray Society (1903-1908) American Quarterly of Roentgenology Vols I-V (1906-1913) American Journal of Roentgenology Vols I-IX (1913-1922) American Journal of Roentgenology and Radium Therapy Vol X-XXXIII (1923-1937) Author and Subject 1903-1937. Compiled under the direction of the Publication Committee and the Editorial Office of American Roentgen Ray Society 836*
- BERKELEY C. MYNS, BONNEY VICTOR and MACLEOD D. UGLAN. *The Abnormal in Obstetrics 384*
- BRIDGEL A. C. J. *Surgical Treatment of Hand and Fore arm Infections 120*
- BROWN G. R. E. VAN INCEN. *The Surgery of Oral and Facial Diseases and Malformations Their Diagnosis and Treatment Including Plastic Surgical Reconstruction 4th rev. ed 123*
- CARRILLI KAM N. *Ydroventriculografia (Tosa posterior) 815*
- CLAUFF CHARLES and LATARJET MICHEL. *Anatomie chirurgicale du crâne et de l'encéphale. Published under the direction of André Latarjet 256*
- CUTLER MAX, BECKHEE ERNEST and CANTRELL SIMON T. *Cancer Its Diagnosis and Treatment 253*
- DELFY J. SEYMOUR B. *The Principles and Practice of Obstetrics 7th ed 10*
- FEDMAN MAURICE. *Clinical Roentgenology of the Digestive Tract 837*
- GRADWHL R. B. II. *Clinical Laboratory Methods and Diagnosis a Textbook on Laboratory Procedures with their Interpretation 4th ed 383*
- HANDFIELD J. VAN K. M. and FERRIT J. M. *The Essentials of Modern Surgery. Edited by I. M. Handfield Jones and A. L. Ferrit 03*
- HERTZLER ARTHUR C. *Surgical Pathology of the Diseases of the Mouth and Jaws 539*
- JORDAN HENRY H. *Orthopedic Appliances, the Principles and Practice of Brace Construction for the Use of Orthopedic Surgeons and Bracemakers. Foreword by F. G. Brackett 539*
- KELTZER SAMUEL J. *Surgery of the Ear. Edited by Samuel J. Koltzky 384*
- KRYNEN FRANK HAMMOND. *Light Therapy 2d rev. and enl. ed 837*
- LEDERER FRANCIS L. *Diseases of the Ear Nose and Throat 255*
- MAJOR KATZIR H. *Classic Descriptions of Disease with Biographical Sketches of the Authors 2d ed 703*
- MAILLER GUY PIERRE. *Le traitement non sanglant des fractures du rachis fractures récentes—fractures anciennes technique et résultats 540*
- MARSHALL C. JENNINGS. *Chronic Diseases of the Abdomen a Diagnostic System 03*
- MEANS JAMES H. and RICHARDSON EDWARD P. *The Diagnosis and Treatment of Disease of the Thyroid 539*
- MILLER HENRY R. *Angina Pectoris Nerve Pathways Physiology Symptomatology and Treatment 836*
- MUNRO DONALD. *Cranio-cerebral Injuries Their Diagnosis and Treatment 383*
- NATGELE FRANK CARL. *The Obliquely Contracted Pelvis. Containing also an Appendix of the Most Important Defects of the Female Pelvis. Centennial Edition Newly Translated from the Original German by Alfred M. Hellman and George Musa 122*
- PELOUSEY J. S. *Gonorrhea in the Male and Female a Book for Practitioners 3d rev. ed 835*
- PORTMANN GEORGES, KETROVITZ H. DESTONS J. LE DUC I. and MARTINAUD G. *A Treatise on the Surgical Technique of Otorhinolaryngology Translation by Pierre Viole 836*
- ROGERS LAURENT and D'ARRELL A. L. *Everyday Surgery With an Introduction by G. Grey Turner 541*
- ROUVIERE H. *Anatomy of the Human Lymphatic System A compendium translated from the original Anatomie des lymphatiques de l'homme by M. J. Rouvier 541*
- SCHOLDER CHARLES LOCKE. *The Treatment of Fractures 11th rev. ed 703*
- SPATH EDWARD B. *The Principles and Practice of Ophthalmic Surgery 835*
- STINSON BARBARA BARTLETT. *A Manual of Fractures and Dislocations 540*
- The 1938 Year Book of Physical Therapy. Edited by Richard Kovács 837*
- The 1938 Year Book of Radiology. Diagnosis Edited by Charles A. Waters and Walter B. Furor Therapeutics. Edited by Ira I. Kaplan 837*

